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BY

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To His Pupils.

FOR WHOSE INSTRUCTION HE HAS LABORED, AND WHO HAVE REWARDED
HIM BY THEIR HONEST ENDEAVORS TO MAKE THEMSELVES
USEFUL TO THEIR SUFFERING FELLOW-MEN,
THIS VOLUME IS AFFECTIONATELY
DEDICATED BY THE
AUTHOR.

PREFACE.

It was the purpose of the author, in the preparation of this work, to supply, within the compass of a single volume of moderate size, the instruction necessary to a full understanding of all the subjects belonging properly and exclusively to Surgery: the volume being intended as a text-book for students, and, at the same time, as a direct and complete guide to the surgeon. In short, it was proposed to supply precisely that which a long experience in teaching and in the practice of surgery have suggested to be most needed by students and practitioners. To this end each department has been treated with as much conciseness as was consistent with precision and completeness; much of the literature of surgery has been omitted; questions which affect only remotely the conduct of the operator have been discussed with brevity; and there has been substituted, whenever it seemed necessary to a thorough comprehension of the subject, a more minute description of the surgical anatomy, and of the most approved operative procedures, than is usually found in similar treatises.

The excellent classical nomenclature of diseases, drawn up by a joint committee appointed by the Royal College of Physicians of London, has been accepted and adopted by the author as the most suitable "universal" and standard nomenclature hitherto devised; the terms chosen by the Royal College being indicated in the subsequent pages by the letters R. C.; retaining, however, the more familiar terms generally employed by English and American writers, and which have in some sense become "national." To these have been added, as far as seemed useful for the purposes of reference and study, various other synonyms, some of which are almost obsolete, but deserve to be remembered, as indicating the changes resulting from the progress of science; while others are accepted at the present day as interchangeable, the choice of terms depending upon whether the subject is contemplated from an anatomical, a pathological, or clinical point of view.

Some of the illustrations are from original drawings and photographs; others have been borrowed from Erichsen,* Gross, Druitt, Fergusson, Stellwag, Wales, Bigelow, Bennett, Bumstead, Barwell, Bigg, Sayre, Davis, Taylor, Bauer, Wells, Tröltsch, Tobold, Bright, Stellwag, Billroth, Gray, Bozeman, Arnold, Flint, Jr., the publications of the Surgeon-General's office at Washington; from the author's treatises on Fractures and Dislocations and Military Surgery; from Tiemann & Co., Darrow & Co., surgical instrument-makers, of this city, and from other sources.

The author desires, also, to express his indebtedness to Frederick A. Castle, M.D., Lecturer on Diseases of Infancy at the Bellevue Hospital Medical College, for his careful revision of most of the proof-sheets; and also to his intelligent pupil, Frederick E. Hyde, and to Dr. Frank Deems, for a similar service, especially in the preparation of the Index and Table of Contents. Nor can he omit to mention his obligations to his publishers for their uniform courtesy and patience under delays for which they were in no way responsible, and for their liberality in placing at his disposal experts and material to perfect the illustrations.

NEW YORK, July 1, 1872.

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* We especially have to thank Dr. Erichsen and his publishers, the Messrs. Longman, Green & Co., of London, for their kindness in granting permission to use many of their excellent wood-cuts.

PREFACE TO SECOND EDITION.

In this edition the typographical errors of the first have been corrected, certain statements have been modified, and a few important facts have been added. Beyond this no changes have been made, except that the Index has been greatly extended; the latter service having been performed by a friend and former pupil, Dr. E. D. Fergusson, of Essex, N. Y.

The author takes this opportunity of saying that he fully appreciates the kind and often too charitable notices of the Press, and that he would gladly avail himself of its just criticisms; but that to repeat and discuss the various opinions entertained in regard to surgical pathology, and to describe all the different modes of procedure in surgical operations practised and approved by others, would have been to defeat the original purpose of this volume, namely—to furnish "a text-book for students, and a direct and complete *guide*" in surgical practice, according to the author's own views of the subject. A "Complete Treatise," in the general acceptation of that term, has not been attempted, nor does it seem probable that any one man can hereafter accomplish a labor of such magnitude.

NEW YORK, March 1, 1872.

PREFACE TO THE THIRD EDITION.

THE preparation of a new and thoroughly revised edition of this Treatise has long been contemplated, in order that it might properly represent the progress of surgical science, but circumstances have until now prevented the accomplishment of this purpose. Inasmuch, however, as this edition has the benefit of the author's later experience and study, it is hoped that the reader will have no reason to regret the delay.

The original intention and scope of the work, as represented in the preface to the first edition, has been in the present edition rigidly adhered to. There has been no attempt to render it an encyclopœdia of surgery by a labored reference to obsolete opinions, or by a description of discarded procedures; but only those methods which, in the experience of the author, have been the most satisfactory, or which, after careful consideration, most commend themselves, have been described in all the detail required by the practical surgeon. In short, the author has sought to reproduce the lessons which, during more than forty years of public teaching, he has labored earnestly to convey to the many thousand young men who have listened to his instructions.

It is within the period of the author's early professional life that anæsthetics were introduced, which, while they contributed greatly to lessen the sum of human suffering, have, in a degree scarcely less marked, extended the range of useful surgical operations. It is also within the period of his later life that antiseptics have been popularized, with the effect, it is claimed. of having still further enlarged the bounds of legitimate surgery, and of giving extraordinary promise for the "surgery of the future." To one whose experience has been obtained while these changes were in progress—a period so brief in point of time, but so widely separated in their practises, pretences and hopes, it will be granted to institute comparisons, and to draw conclusions. This privilege has been exercised in the following pages whenever a suitable opportunity has been presented.

FRANK H. HAMILTON.

43 W. 32D STREET, NEW YORK,
March 1, 1886.

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PART FIRST

GENERAL SURGERY

CHAPTER I.

INFLAMMATION.

Syn.—Inflammatio, (R. C.)

Section 1.—General Considerations.

Broussais wrote, more than half a century ago, "It is of an inflammation of one or more of the organs essential to life of which, sooner or later, a vast majority of the human family perish;" and I will supplement his great aphorism by the precept: *Irritation* constitutes the first link in the chain of morbid phenomena resulting finally in inflammation; or, to be more precise, irritation is the only invariable condition immediately precedent to inflammation. Without this supplement the doctrine of Broussais is therapeutically inconclusive, inasmuch as the treatment of inflammation is essentially, from first to last, the treatment of irritation.

If exception be taken to this statement on the ground that in some cases inflammation exists or originates in tissues not known to be supplied with nerves, as, for example, in cartilage and fibrous structures, it is sufficient to say that if such tissues are not supplied with nerves, they are at least not beyond their vitalizing influences. Textural irritability is fully recognized as it exists in vegetable life; and in all forms of animal life, molecular disturbance and increased molecular activity soon cease in parts from which the nervous influences are wholly withdrawn.

Moreover, irritation is the direct and sole cause of many surgical accidents in which the interposition of inflammation cannot always be demonstrated, and of some few in which it plainly does not exist; such for example as nervous shock, tetanus, traumatic fever, traumatic delirium, &c.

We see, therefore, how important is the rôle performed by irritation in its relation to surgical accidents and maladies.

Irritation, whether general or local, may be caused by whatever agencies are capable of disturbing the germinal textures, or the nervous system directly.

Definition and Pathology.—Instead of attempting to define inflammation, or even to explain all its phenomena, which, as Mr. Simon justly says, "would be in fact to explain life," it will be more prudent to state certain pathological conditions which are known to be present, and the signs by which the presence of these conditions are usually indicated.

The following statements, made in a somewhat aphoristic form, may be considered as embodying the most important and best established physiological and pathological facts relating to inflammation.

All vital actions are processes of growth and decay. Inflammation is, with slight qualifications, exaggerated local vital action. Molecular disturbance commencing in the germinal structure is propagated thence to other structures. Under the influence of an irritant the blood-vessels, both arteries and veins, in most cases become speedily dilated. The blood flows at first more slowly through these dilated vessels; but the current soon becomes more rapid, and finally the current is again retarded or ceases altogether, constituting the condition denominated the congestion or stasis of inflammation. The temperature of the blood in the inflamed part is elevated; the blood is probably also more highly oxidized; the proportion of fibrin is increased, while the proportion of the salts and of albumen is diminished.

The capillaries, also, dilate in the stasis of inflammation. As a result of mechanical pressure certain elements of the blood escape from the capillaries by transudation; or these elements are attracted and withdrawn by the vital force of the disturbed germinal structures. The elements thus exuded constitute the plasma or the nutriment which enables the cells, or corpuscles, to grow and multiply themselves. New vessels are formed. Occasionally vessels are ruptured by excess of engorgement and blood is extravasated. In connection with the rapid growth or proliferation of tissues, consequent upon the increased vital actions, there is waste or destruction. The increased activity causes the original tissues to die and become effete, and their places are occupied by precipitately formed and imperfectly developed structures, some of them being merely abortions of structural existence, which in their turn are again cast off. Hence ensue ulceration, caries, suppuration, abscesses, gangrene, and necrosis.

It seems to be now generally admitted that during inflammation the proportion of white corpuscles is notably increased, and that there is no distinction between such cells and "pus cells," "wandering cells," "young exudation cells," and "lymph cells."

Terminations.—Clinically speaking, and without reference to the precise pathological changes which occur in inflamed tissues, we are accustomed to say that inflammation terminates in the effusion of pus, mucus, serum, or fibrin; in ulceration, gangrene, resolution, and cicatrization. These divisions, in the progress of science, have lost much of their original signification, but they still retain sufficient practical value to deserve to be mentioned. The conditions named are not in all cases terminations of inflammation; most of them are concomitants, others are results, terminations, and remote sequences.

Local Signs.—Inflammation, when sufficiently superficial for its phenomena to be observed, is characterized generally by the following signs: heat, redness, pain, and swelling.

Among the many forms of inflammatory action which exist, there is a constant variation in the relative preponderance of these several phenomena; the prominence of the one or of the other depending upon the character of the structure implicated, the condition of the general system, the specific nature of the cause, and upon various other circumstances.

The *redness* is due mostly to the increased amount of blood contained in the tissues of the part affected, perhaps also in part to the increased oxidization of the blood. If this increased vascularity and redness is not apparent to the naked eye, it seldom or never fails to manifest itself in the careful microscopical examination.

The *elevation of temperature* is in part due to the same cause; namely, to the greater vascularity of the inflamed tissues; but, contrary to the opinion entertained by John Hunter, the temperature of the blood in the part inflamed may "rise above the standard heat at its source;" for while the temperature of the blood at the heart in man is never much above 98° Fahrenheit, the temperature of parts suffering under acute inflammatory action may rise to 112°, and some have affirmed that this is not the extreme limit which has been observed.

It is apparent from these observations that the process of inflammation is in some way connected with a process of calorification. Perhaps the increase of sensible caloric is the mechanical result of the arrest and attrition of the circulating fluids; the evolution of heat constituting only a new manifestation of power. It has been suggested also, that it may be due to the rapid oxidization of the blood, or to the increased vital actions of growth and decay.

In certain cases, patients complain of a sensation of heat which would seem to imply a temperature far above the normal standard; and which they describe as "hot" or "burning," when the thermometric test does not indicate an elevation of more than one or two degrees. This phenomenon is due to certain morbid conditions of the nerves. The sensations of the patient, therefore, constitute no reliable indication of the actual heat of the system, or of the parts inflamed.

Pain, and more especially sensitiveness, or that condition which we term *tenderness*, is rarely absent in inflammation. Exalted functional activity of the nerves is probably in itself fully adequate to the production of pain; but in inflammation, pressure, as a result of structural engorgement, becomes an additional cause of pain. Tenderness represents the specific effect of the neurotic pressure accompanying inflammation more completely than pain. It is probably a combined sensation; due to a condition of tension in a large number of terminal nerves at the same moment. The point of a needle causes pain, but does not develop the sensation of tenderness; while pressure made by the ball of the finger causes a sensation of tenderness often without giving rise to pain. Whatever may be the explanation of the fact, it is certain that, for the purposes of practical diagnosis, tenderness is regarded as more conclusive than any other single sign; while pain is almost the least conclusive.

In some cases where organs of special sense are implicated, exaggerations of the specific normal sensations are substituted for pain; as for example, the eye experiences flashes of light, the ear is disturbed with unreal sounds, the senses of taste and of smell are exalted or perverted. It is true, however, that in most cases the action of the special senses is simply obtunded.

At other times reflex sensations of pain coexist with the pain referred directly to the part inflamed; or they may even exist independently of this pain, as when, the hip-joint being diseased, pain is experienced in the neighborhood of the knee, but not at the hip-joint; but tenderness does not fail at the hip, while it is often absent at the point of the reflex sensation.

Inflammation also causes sometimes reflex sensations which can neither be termed pain nor tenderness, as when irritation or inflammation of the eye causes sneezing, or inflammation of the lungs, pleura, or liver occasions cough.

Swelling, as it occurs in ordinary œdema, is due almost exclusively to serous or watery infiltration; but as it occurs in inflammation, it is due to the effusion of serum with various other elements of the blood, but which effusions are neither uniform in their character or proportions. The swelling in inflammation is due, moreover, to proliferation of germinal matter, or of cell growths; to dilatation and engorgement of arteries, veins, and capillaries; in some cases to rupture of the blood-vessels, with extravasation of their contents into the adjacent tissues; and finally, to the complete formation and organization of new vessels and other tissues.

To the four classical local signs of inflammation above enumerated may be added, *functional disturbances of the special organs which are attacked.*

Constitutional Signs.—The general or constitutional signs of inflammation are:—

First, the ordinary signs of irritation and fever, constituting traumatic or symptomatic fever, especially marked by excessive elevation of temperature.

Second, an abnormal condition and appearance of the blood, after it is drawn from the system; or what is usually known as the "buffed and cupped" condition of the blood; it having been long observed that, when blood is drawn in a full stream from a person laboring under acute inflammation, especially if it is received into a smooth porcelain vessel, and then is allowed to stand without being disturbed, at first the surface assumes a bluish-white appearance, called "sizy;" and after a time the color changes to a pale yellow, or buff, while the edges are slightly raised and drawn inwards, forming upon the surface a shallow cup. On lifting and removing the buffy surface, the portion below is found to be of a bright arterial color, and firmly coagulated, forming what is known as the clot or crassamentum. The upper or buffy layer is composed essentially of fibrin and white corpuscles, and the lower is composed chiefly of red corpuscles.

The immediate cause of this phenomenon has not been fully explained, further than that, owing to some peculiarity in the blood, the red corpuscles have been permitted to separate and to precipitate themselves in coherent masses before the fibrinous elements have become coagulated.

To add to our perplexity, it is well known that the same appearance is sometimes presented where there is no reason to suppose the existtence of inflammation; as, for example, in certain forms of low fevers, in scorbutus, during pregnancy, after long exposure to cold, when the system is exhausted or fatigued.

John Hunter thought that the buffy appearance of the blood indicated not so much an exalted condition of the vital powers, as an increased and labored action of those powers which exist. The opinion of Mr. Simon, that "the increased fibriniferousness of the blood in inflammation represents actions of devitalization and decay in some albuminous material," is not inconsistent with these early doctrines of Hunter.

Varieties of Inflammation.—The phenomena presented by inflammation are not uniform; but while they constantly retain certain essential characteristics, they vary materially, according to the conditions of the general system, the specific cause, the organ or tissue attacked, etc. Thus, inflammation may be properly divided into acute, subacute, and chronic; into pure phlegmonous inflammation, erysipelatous, scrofulous, syphilitic; inflammation of the skin, of the areolar tissue, of the muscular and fibrous tissues, of the synovial surfaces, periosteum, bone, and medullary tissue. These constitute only a moiety of the various conditions under which inflammation may occur, each one of which presents some features peculiar to itself. They do not all, however, demand separate and special consideration in this place.

SECTION 2.—ACUTE INFLAMMATION.

Pure phlegmonous inflammation, usually denominated acute inflammation, occurring independent of specific constitutional causes, invading the areolar tissue, or other superficial soft structures, furnishes the typical example of inflammation, and its treatment will be considered first and most in detail.

As has already been intimated, irritation and inflammation sustain to each other the relations of cause and effect. In order, therefore, to prevent the accession and to accomplish the cure of the latter, it will be necessary first to effect the removal of the former. *Sublata causa tollitur effectus.*

The source of textural or nervous disturbance is not always apparent; nor is it certain that, having been discovered, it can be removed, and especially since inflammation, in itself a result of irritation, becomes when once established, by reciprocity of action, a cause. The soundness of the general principle above stated is not, however, impaired by our occasional inability to accomplish what is desired.

I desire then, by repetition, to give prominence to this idea, which appears to me to lie at the foundation of all correct practice, but which, perhaps through inadvertence, has not always been distinctly enforced by classical writers, namely, that the primary indication of treatment in all inflammations is to remove as speedily as possible the sources of irritation. I would go farther and say, that from beginning to end the successful management of inflammation depends upon the employment of such agents and such measures as either directly or indirectly act as sedatives. When the disturbing cause is purely local, its removal may be sometimes easily accomplished by the interposition of a surgical operation, as by the extraction of splinters, fragments of bone, balls, and other foreign substances. For this purpose also diseased joints are resected, pent-up fluids are evacuated, strangulated tissues are released, and acrid discharges are rendered innocuous or promptly displaced.

If the cause consists in the presence of some foreign and septic material in the circulation, or in some other general, systemic fault, its removal is in most cases more difficult. Therapeutical treatment is then alone competent to meet the indications.

Local Treatment.—First, *water*, of a suitable temperature. Water possesses two attributes of especial excellence. It softens the dense cuticle, and by absorption relaxes the tension of the deeper tegumentary layers. It is also the most convenient vehicle for the administration of temperature.

Cold, considered as the negative, or absence of caloric, is unquestionably a direct sedative; but experience shows that in consequence of the reaction which often results from the application of extreme cold, it becomes indirectly a stimulant or excitant. Water, therefore, at a temperature only a little below the temperature of the part inflamed, is a more reliable antiphlogistic than water at or near the freezing point. It may in general be affirmed that that temperature is most useful which is to the patient most agreeable; and in most cases this is from 70° to 90° Fahrenheit. Exceptions occur, however, to this rule, in which either an elevation or depression of the temperature proves at the same time more pleasant and more salutary. Of late I have demonstrated the efficacy of *hot* water, or of water at about a temperature of 112° Fahr., and especially in the case of lacerated wounds.[1]

Water may be applied in various ways; by continuous irrigation, by the application of moistened cloths often renewed, by baths, by poultices and fomentations, or finally by simply moistening the naked surface occasionally with tepid water, and trusting to evaporation to depress the temperature.

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[1] See "Warm and Hot Water in Surgery," by the Author. *Louisville Jour. Med.*, Jan., 1874; also, *Med. Rec.*, May 15, 1874.

Simple water, employed in some one of the forms above indicated, we have found to possess all the virtues which have from time to time been attributed to medicated waters; and we no longer think of adding acetate of lead, solutions of opium, or of morphine, or any other of the various sedative salts or alkaloids, unless it be in those examples in which pain or local irritability constitutes the predominant symptom, and for the relief of which we sometimes find reasons to prefer the local application of morphine or of opium, to the exhibition of the same remedies by the stomach or by injection.

Elevation of the inflamed part is scarcely second to temperature, as a means of controlling inflammation. Its effect is purely mechanical• relieving the engorged vessels by drainage.

Absolute rest is essential, in connection with posture. This is sufficiently recognized in most cases by all surgeons; and indeed the patients themselves generally in this regard demand what surgeons may omit to enforce. The pain caused by motion induces them to seek rest.

Removal of pressure has not always been regarded as a means of alleviating inflammation. At one time and another surgeons have sought to subdue acute inflammation by pressure. Acute testitis has been treated by adhesive plasters, and attempts have been made to strangle acute synovitis by bandages, but we have never seen any result from this practice but pain, and unmitigated mischief.

We will not deny that strangulation, employed before the accession of inflammation, may sometimes prevent its development; nor that compression is of great service in the removal of the products of inflammation, but we doubt whether it ever lessened an existing acute inflammation.

Water, in so far as it relaxes the surface, and position as a means of drainage, are effective by the removal of pressure; but there are cases, also, in which a broken limb must be removed from the restraints of splints and bandages, in order that the inflammation may be more certainly controlled.

The application of *leeches* for the purpose of abstracting blood was at one time in much greater favor than now, having of late gone very much into disuse, with general bleeding; nor is it to be regretted. With very few exceptions its utility is more than doubtful; and, in consequence of the irritation which the bite of the leech sometimes occasions, it quite often, when applied directly to the inflamed surface, does palpable harm. Some years ago the author made several experiments in order to determine the value of leeches as a means of local depletion, one of which may be briefly stated as follows:—

To a finger suffering under acute phlegmon was applied a large Swedish leech, having previously measured the size of the finger by the amount of water it could displace in a graduated glass. The leech filled itself and fell off; and although it had drawn what was in bulk equal to twice the size of the finger, when the finger was again placed in the glass its size was found to be precisely the same as before. To speak of this as an example of local depletion is evidently absurd, yet it is quite probable that in a majority of cases in which leeches have been applied no more local depletion has occurred than in the case of the experiment related.

As revellents, applied to parts somewhat remote from the parts affected, and occasionally as means of general depletion, they are, in certain cases, agents of unquestionable value, but they ought seldom or never to be applied directly to the parts inflamed.

Incisions, made with the knife, have more claim to be considered local measures of depletion than leech-bites, for the reason that, if they do not cause as much blood to escape, they open a larger amount of hyperæmic and infiltrated structure, and whatever does escape comes directly from the suffering tissues. But incisions are in themselves lesions which almost inevitably provoke reactions, and they must be reserved for extreme and exceptional cases—for cases such as felons, in which the density of the surrounding tissue, by its tension and pressure, increases the inflammation and accelerates suppuration; and for cases of acute phlegmonous inflammations of the areolar tissue, which are about to result in death from strangulation.

But it is especially in the inflammations of asthenic type, such as erysipelas, carbuncle, furunculus, etc., or in inflammations which result from the extravasation of urine, or of other highly irritating materials, that incisions perform their most important functions.

It is not, then, so much for the purpose of depletion, as for the purpose of "unbridling" strangulated tissues, that we practise incisions. Mere scarification, or superficial incisions, do not accomplish this end. They cause wounds which do not relieve the tension, and which find no adequate compensation for the direct injury which they inflict in the small amount of blood which escapes. Incisions, to be beneficial, must be deep and long.

Stimulants.—There is another class of local remedies which experience has proven to be useful in certain inflammations, and which are not direct sedatives. They are, in fact, all of them more or less active stimulants. The remedies belonging to this class are very numerous, of which the following furnish examples:—Solutions of nitrate of silver, sulphate of zinc, superacetate of lead, employed in inflammations of the conjunctiva; muriated tincture of iron, tincture of iodine, solutions of bromine, alcohol, employed in erysipelatous inflammations; vinegar, spirits of turpentine, carbolic acid, in burns; vesicants in furunculi; nitrate of silver, tincture of iodine, lye obtained from the leeching of ashes, employed occasionally in the treatment of felons.

It is said of this class of remedies, that they give tone to the vessels;

or that they change the action from morbid to healthy. It is equally pertinent to say, that they exhaust the irritability, either of the germinal textures, or of the nerves which minister to these textures, and in this way become indirectly sedatives. The first effect is in all cases an increase of irritation and of pain, accompanied with increased vascular engorgement; but this condition is more or less speedily followed by a subsidence of irritation, and a diminution of vascular turgescence; and it is worthy of special notice that, when the irritation and vascularity have once been made to disappear under this plan, they are much less liable to return than when the same ends have been accomplished by cold or other direct sedatives. Cold subdues irritation very promptly—often instantly; but when the application of cold is suspended, unless it has been continued a long while, the local excitement promptly returns; while by reverse, stimulants subdue irritation more slowly, and only after having caused its increase, and when the application is suspended the excitement does not so soon return.

Stimulants, as indirect sedative applications, have certain advantages over direct sedatives; but clinical experience teaches that they are occasionally liable to induce primary reactions so violent as to prove destructive, and from which no sedative results ensue; and, moreover, that they are not available in the treatment of all forms of acute inflammation. They are especially serviceable in burns, erysipelas, and in certain other forms of inflammation dependent upon blood poisoning, or general dyscrasy; they are almost exclusively relied upon in inflammations of the conjunctiva, of the urethra, and in most inflammations of mucous membranes, whether acute or chronic; but they seldom act beneficially in acute inflammations accompanying recent and open wounds. It may indeed be stated, as a rule, that stimulating applications are inadmissible in traumatic lesions accompanied with acute inflammation. No doubt, however, many exceptions exist to this rule as here stated, especially in its reference to those cases of recent wounds occurring in persons the vital forces of whose systems are already considerably depressed; and in this statement we shall find a partial explanation of the beneficial effects claimed to be obtained from the application of carbolic acid, solutions of the chloride of zinc, alcohol, etc., to recent wounds.

Constitutional Treatment. It is an error to suppose that inflammation finds a favorite and congenial soil in that condition which we denominate "good health." It is equally an error to suppose that it is nourished and sustained only by plethora of the vascular system, or that it flourishes especially in those whose vital forces are above the normal standard, or whose vital processes are in a state of abnormal activity.

These opinions regarding the sources of inflammation are probably never correct as applied to the chronic forms; they are very seldom correct as applied to those forms which depend upon blood-poisoning, or general dyscrasy, and they are often incorrect as applied to acute phlegmonous inflammations of a non-specific character.

The fact is, that inflammations of all grades and forms are most often originated in persons who are feeble, debilitated, or even anæmic. Moreover, the course of an acute inflammation in such a person is the most violent, rapid, and destructive. Peritonitis, ensuing upon exhausting hæmorrhages after childbirth, the destructive corneitis following choleraic discharges, and the central, corneal " starvation ulcer " of imperfectly nourished children, are no more illustrative examples than come daily under the notice of almost every practitioner.

If it must be admitted that a condition of plethora, or a certain so-called "exaltation of vitality," may in some exceptional cases predispose to inflammation, it is nevertheless true that perfect health never does. Inflammation finds little or no support in a system where all the organs perform their functions in a quiet and perfect manner. If in such a condition of the body inflammation is by chance awakened, it will soon die out spontaneously for lack of nourishment; and if we were required to formularize the general treatment of both acute and chronic inflammations, it would be in these words: "Maintain or restore to the general system perfect health."

Bleeding.—But if in any case the surgeon is persuaded that this morbid action is maintained by an excess of vital fluids or of vital functions, let him bleed his patient. There is certainly no other way in which their reduction can be so promptly and so completely accomplished. The fact, however, that surgeons and physicians do not to-day bleed their patients so freely who are suffering under inflammation, must be accepted as evidence that observation has taught them what their theories have not, namely, that general phlogosis is not very often a cause of inflammation. Practice has at length ceased to be controlled by a false doctrine.

If the patient laboring under acute inflammation has a gross and turgid look, such as is often presented by persons of inordinate appetites, accompanied with great powers of digestion and assimilation, it may be proper at an early period, and before effusions have taken place to a great extent, to abstract blood from the general circulation; but if the person is accustomed to drink habitually, yet with moderation, wine, ale, or alcoholic liquors, bleeding must be practised with caution; and if he has been in the habit of using such stimulants daily in excess, or has been lately in a debauch, bleeding is wholly inadmissible; and in advanced life, also, when the processes of repair and of conservation are feeble, it must not be forgotten that a single large bleeding may induce a permanent and perhaps fatal exhaustion. For the rest, we must leave it to the judgment of the surgeon to decide when it will be proper to bleed, only reminding him again that blood-letting is a spoliative remedy of great power, and that experience has demonstrated that inflammation may generally be treated successfully without its aid.

Cathartics have probably a wider application than any other class of constitutional remedies, in the case we are considering.

They are useful, first, by removing from the stomach and bowels unwholesome ingesta, and acrid fæcal accumulations. Second, by increasing the secretions from the gastric and intestinal glands, and from all those glands, such as the liver and pancreas, which minister to digestion and assimilation. Third, by their action as revellents; operating upon an extensive surface which is in immediate sympathy with the organic system of nerves, they are capable of exerting a most powerful influence in withdrawing nervous action from other and remote parts of the body.

Nauseants. At the same time that surgeons have become more conservative in the use of the lancet, they have also abandoned in a great measure its natural allies, such as the tartrate of antimony and ipecacuanha. Employed with discretion, these, and other similar therapeutical agents, have often proved useful, especially in the acute inflammations of robust adults; but their ability to do good, when employed indiscriminately, seems quite counterbalanced by their ability to do harm, and their decline in public favor ought to be accepted as evidence that this impression is not without foundation.

Diaphoretics, such as the several combinations of opium with nauseants, and the various stimulating diaphoretics, have a limited application, especially when the inflammatory action is accompanied with unusual heat and dryness of the skin.

Diuretics, as another means of eliminating peccant humors, are excellent aids and supplements to diaphoretics.

Opium, in some of its various forms, is indicated where pains, restlessness, or watchfulness are predominating symptoms.

Nutrition and stimulation. Finally, in all cases where the patients are feeble, pale, anæmic, or suffering under blood poisons, nutrition is the first and most important general remedy, and in these cases also, tonics and stimulants are important just so far as they may aid digestion and consequently nutrition. They must, therefore, be employed with moderation; and they ought, as far as possible, to be rendered palatable and grateful to the stomach.[1]

SECTION 3.—CHRONIC INFLAMMATION.

The existence of chronic inflammation implies, in general, either a continuance of its cause, or some fault in the general system. In by far the largest proportion of cases, the original cause has been removed or has ceased to act, and the condition of the general system is alone responsible for the persistence of the malady. If this were not so, these inflammations would in most cases disappear spontaneously, under the natural restorative powers of the organs affected. With this view of the subject we are prepared to understand why they do not yield more readily to local treatment; and why, even under well-directed constitutional treatment, they so often prove intractable. They demand nothing less than a complete restoration of health and of constitutional vigor.

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[1] "Alimentation in Surgical Diseases," by the Author. *Hosp. Gazette*, Jan. 15, 1878.

Constitutional Treatment.—The prominence given in the preceding observation to the condition of the general system, as a cause of chronic inflammation, and as a ground of its maintenance, renders it proper that the treatment of the general system should be first considered; but the deviations from health are so various, and the causes of these deviations are so much more various, it will be impossible to indicate fully all the proper therapeutical means. Fortunately, however, a vast majority of these cases, although they may differ widely in the special pathological characters of the constitutional dyscrasy, may be classified clinically as examples of enfeebled constitutions, and as demanding therefore nutrients, tonics, and perhaps stimulants. Scrofulous inflammations may demand iodine; syphilitic inflammations may demand mercury; inflammations depending upon blood poisoning may demand other special agents for their successful elimination, but nearly all alike demand nutrition. Emaciation, pallor, loss of appetite, muscular debility, with nervous irritability, and in some cases an irregular hectic fever, constitute the *tout ensemble* of these pitiable cases. The portrait answers equally for the closet and pulpit-worn clergyman, suffering with chronic bronchitis; for the broken-down inebriate, or the scrofulous child, led from dispensary to hospital with chronic ophthalmitis; for the boy halting with chronic synovitis; for the woman, the victim of civilization, the heir to wealth and luxury, suffering and childless from chronic metritis.

The remedy is to be found in such hygienic means as air, light, exercise, an abundance of plain, nutritious food, tonics, and possibly stimulants to aid nutrition, freedom from perplexing cares or mental disturbances of any kind; and I need scarcely say, that medicines of this kind are found out-of-doors, on the mountains, upon the sea-shore, in the saddle, and almost anywhere but in houses, hospitals, or drug-shops.

As to the specific causes of general dyscrasy, it will be necessary to mention only a few as illustrative examples, such as disorders of the stomach, liver, or kidney; the strumous, rheumatic, syphilitic, and gouty diatheses; with all the various forms of septicæmia, or blood-poisoning.

Local Treatment.—While constitutional means are essential in the treatment of most chronic inflammations, local means are also often valuable as auxiliaries; and in some few cases they are indispensable, as means of interrupting a catenation of morbid processes which have become habitual, and which retain a power of self-continuance and propagation.

Cold and *other direct sedatives* possess a limited value in this class of inflammations. If they do occasionally prove serviceable, it is rather by the reaction which they induce, than by virtue of any property which they possess as sedatives.

Stimulants applied locally—and under this class I venture to include all remedies which on application cause a sensation of heat or of smarting—are not limited, as in their application to acute inflammations, to certain tissues, and to specific varieties; but they may be employed generally with advantage in nearly or quite all forms of chronic inflammations, even in open wounds of the soft tissues, in articulations, and in the interior of bony structures.

Counter-irritants, which are supposed to act by establishing new points of irritation, and in this manner to withdraw somewhat proportionately from the irritation existing in the parts diseased, are certainly sometimes useful; but when employed indiscriminately they are competent to do much harm. By the pain and exhausting discharges which they frequently occasion, they harass and enfeeble the patients, inflicting more irritation upon the general system than they abstract from the diseased structures, and thus defeat the most important aim of all treatment, namely, the improvement of the general health.

Blisters, setons, the moxa, the hot iron, pustulation with croton oil, or with the ointment of antimony, tincture of iodine, and the cupping glass, are among the means employed by surgeons to produce counter-irritation; and whichever is used, the surgeon will take care not to apply them too near the inflamed structures, nor to continue their use when they cause much and continued suffering, or even marked disquiet.

Compression, accomplished in various ways, by bandages, adhesive strips, sponges, and elastic bands, when employed in the treatment of chronic inflammation, is not liable to the same judgment as when employed in the treatment of acute inflammation. It seldom does harm, and it certainly often aids materially in dispersing the products of inflammation.

Rest.—Examples may be furnished in which rest is an important element in the treatment of chronic inflammation; thus, for illustration, where inflamed interarticular synovial membranes are, at the same time, undergoing ulcerative degeneration. Rest is important in these cases for two reasons: first, because motion causes such intense pain as to inevitably increase the local and general disturbance; and second, because in these cases anchylosis, or complete obliteration of the synovial sac, and of the interarticular spaces, is the most reliable alternative and resource known to surgery for the termination of the inflammation. Motion breaks up the new and reparative tissue, and prevents the consolidation.

Probably there are a few other cases in which, owing to the extreme morbid irritability of the structures inflamed, temporary rest may prove useful.

Motion and Use.—Nothing, however, is better established than that motion, either passive or active, or the use of an organ, so as to re awaken its normal functional activity, is one of the most valuable loca means of curing chronic inflammation.

Simple chronic synovitis of the knee or ankle joint may perhaps be cured while the limb is at rest; but we have seen multitudes of cases which during many months and years of rest had made no advance towards recovery, but which were permanently cured in an incredibly short time when the patients were compelled to use their limbs. Such attempts are always at first painful, and not unfrequently they are attended with a temporary aggravation of the inflammation; but a persistence in rubbing and flexing the joints, and in walking or otherwise using the limbs, seldom fails to accomplish relief or a cure.

It may be difficult to say sometimes how much of the benefit derived from these procedures may be due to the improvement in the general condition, resulting from out-door exercise; but we have met with examples in which passive motion alone has effected a marked and speedy improvement.

The chronic inflammations of muscles require daily and almost constant use; and this must be practised notwithstanding the pain which it inevitably occasions.

SECTION 4.—ERYSIPELATOUS INFLAMMATION.

Syn.—Erysipelas, (R. C.)

Causes.—It is probable that the existence of erysipelatous inflammation implies always a blood-poisoning, or at least some morbid condition of the circulating fluids. In many cases the character of this blood-poisoning is apparent; as where it depends upon contagion, or upon the presence of urea in the circulation.

Its most common seat is the tegumentary structures, but it may occur in mucous or serous membranes, and probably in most other structures of the body which are continuous. Pyæmia, which so often ensues upon phlebitis, has been regarded by many pathologists as one form of diffuse erysipelas; so also has puerperal peritonitis and diffuse inflammation of the absorbents.

Symptoms.—Erysipelas is attended generally by more or less fever; and in severe cases the fever almost invariably assumes a low type. Occurring in tegumentary structures, it is characterized by rapid diffusion, by a bright red, dusky, and sometimes yellowish color of the skin, by vesications, and burning pains. When the subcutaneous areolar structure becomes involved, abundant serous effusions take place, followed often by rapid yet imperfect suppuration, and by gangrene, especially of the loose connective tissue. In the variety last mentioned, the skin has usually a hard, brawny feel, indicating great effusion of both serum and lymph into the several tegumentary layers.

Varieties.—Erysipelas has been divided into traumatic and idiopathic, according as it occurs in connection with or independent of wounds; into simple and malignant; into cutaneous, cellular (diffuse cellulitis), and cellulo-cutaneous. The traumatic variety is that with which the surgeon is chiefly concerned.

Traumatic Erysipelas.

Traumatic Erysipelas occurs most often in crowded hospitals, and especially in wards filled with suppurating wounds, or which are in the vicinity of apartments containing cases of puerperal peritonitis; and under these circumstances it often spreads by contagion or by infection. Nor ought we to omit mentioning in this connection, as evidence of the intimate relations existing between puerperal peritonitis and erysipelas, that erysipelas is equally capable of conveying to the lying-in woman puerperal peritonitis. Certain seasons of the year seem to predispose to its occurrence, and its irruptions are most frequent and violent during the prevalence of a cold and damp atmosphere. Persons accustomed to the free use of stimulating liquors, whether beer, wine, or alcoholic drinks, are peculiarly liable to its attacks. Feeble, anæmic persons, and those whose cellular tissue is loaded with serum, are equally liable. Affections of the kidneys, and especially Bright's disease and diabetes, are known to be active predisposing causes.

Erysipelas is more liable to ensue upon wounds of certain portions of the body, and of certain structures, than of others. This is especially true of wounds of the scalp, and of wounds of dense fibrous structures in most parts of the body.

Wounds in which suppuration is well established are not so liable to erysipelas as recent wounds; unless they are improperly subjected to irritation, by probing, by attempts to remove fragments of bone, or by other mechanical interference.

Symptoms.—When erysipelas is about to attack a wound, the surface sometimes becomes more dry than usual; but in most cases the fluids, without diminishing in quantity, become thinner, and more offensive; they assume the character of ichor; and if pus has hitherto been present in abundance, it sensibly diminishes, or entirely disappears. Frank, Chomel, and others observe also that more or less swelling of the neighboring lymphatic glands is an invariable prodrome; and they regard this circumstance, therefore, as pathognomonic. Rigors, with a certain amount of general *malaise*, are also very constant precursors.

Soon a blush of redness, accompanied with more or less elevation of the skin, or œdema, is seen spreading outwards into the sound skin, sometimes with defined margins; at other times the redness and œdema are insensibly lost in the adjacent tissues.

In mild cases, when the inflammation is limited to the dermoid tissue constituting the cutaneous form, the redness spreads quite as rapidly as in more severe cases, and may invade an equal extent of surface, but it soon begins to fade out at certain points, and disappears without either suppuration or gangrene. It may disappear wholly in one portion of the integument and reappear in another, constituting the "erratic" form of the malady; or it may make a sudden metastasis from the surface to some internal organ. Both of these latter forms are to be regarded with some apprehension.

In more severe cases, involving alone the cellular tissue, denominated usually "diffuse cellulitis," or involving both the cellular and dermoid tissues, and known generally as the "phlegmonous" variety, extensive subcutaneous suppuration with gangrene is quite common. Parts having a loose and abundant cellular tissue, and underlying a thin, delicate tegumentary covering, such as the eye-lids and the scrotum, are exceedingly apt to slough.

In these latter cases a low typhoid fever usually accompanies the local manifestations, attended not infrequently with delirium and coma. Phlegmonous erysipelas attacking the scalp or face is especially prone to develop at an early period cerebral symptoms.

All inflammations have a tendency to self-limitation, or to spontaneous termination, either in resolution, suppuration, or textural death; but this tendency is more marked in erysipelas than in most other forms of inflammation: the period of its rise, progress, and decline, in those cases which are left to pursue their own course, undisturbed by therapeutical means, being usually from about five or seven to fourteen days. This will perhaps explain why so many and such incompatible measures have from time to time obtained a reputation for the cure of erysipelas.

Treatment.—First in order are the *preventive* means; and these consist, first, in such general hygienic measures as pure air, wholesome diet, and, in short, in the adoption of whatever means are calculated to insure a healthy condition of the general system; second, in the removal of all local sources of contagion or of infection; third, in withholding from the wound all provocations or new sources of irritation. Among the most fruitful sources of traumatic erysipelas is the irritation caused by sutures which hold the lips of a wound in a state of unnatural tension; and upon the first appearance of the erysipelatous blush they should be cut and removed; it is better in most cases not to employ them where coaptation demands that the tissues shall be held with a violent strain. They should be omitted also in persons whose condition implies a constitutional predisposition to erysipelas; and upon the scalp, where experience has shown that this form of inflammation is especially prone to occur.

Adhesive plasters, also, and tightly applied bandages, are quite often active determining causes; partly in consequence of their mechanical pressure, and partly in consequence of the confinement of the acrid discharges which they occasion; especially where proper means for drainage have not been adopted.

In very feeble and anæmic persons, exhausted by long-continued discharges, inflammation of the same character is occasionally developed by simply probing the wound, or by an attempt to remove a loose spiculum of bone. During the late civil war I met with numerous cases in which such slight provocations have caused fatal erysipelatous inflammations.

As **local remedial** means, by common consent among surgeons, that class of applications has been employed which are more or less stimulating, and which I have chosen to designate as *indirect sedatives.* Some of these have been supposed to possess antiseptic properties, which enable them specifically to antidote the peculiar morbid condition of the blood upon which the inflammation remotely depends; such remedies, for example, as the sulphate of iron, the iodide of potassium, the tincture of iodine, bromine, chlorine, the muriated tincture of iron, and the spirits of turpentine. But while it may fairly be considered a question in dispute whether these remedies, or any others yet discovered, possess any specific influence, it is undeniable that they often prove serviceable; but perhaps no more so than alcohol and water applied through the medium of cotton or linen cloth, or than nitrate of silver, applied of such strength as to blacken the surface of the skin; indeed, both nitrate of silver and tincture of iodine will, in some mild, superficial cases, arrest the progress of the malady, if only applied to the sound skin around the entire circumference of the inflamed tissue. As when a counter-fire on the prairies arrests the progress of the flames, because no material is left upon which the fire may feed, so in this case the burning of the healthy textures seems to have destroyed that natural irritability upon which the disease in some measure subsists.

It is proper that I should add, that I have seen a great many cases of erysipelas brought to a speedy and favorable termination by the application of cloths moistened in tepid, warm, or even hot water. In hospital practice warm water is in these cases my usual resource; and it would be difficult for me to say that it has not served its purposes as well as any of the stimulating, or so-called antiseptic applications.

Moderate pressure, made by a neatly applied bandage, if employed within the first two or three days, has been sometimes found capable of arresting the progress of the inflammation; and collodion, laid freely over the surface, is said to have accomplished the same purpose.

Incisions.—As soon as it becomes apparent that suppuration has taken place in the subcutaneous tissue, long incisions should be made freely through the tense tegumentary coverings. It is even proper to do this sometimes when the presence of pus is not well declared, if the skin is in a state of extreme tension, and especially if it has assumed a dark, purplish color. In examples of diffuse cellulitis, constituting one of the most grave varieties of tegumentary erysipelas, incisions ought to be practised when the skin is very tense, without reference to its color.

In both the cellular and cellulo-cutaneous varieties, the general absence of a fibrinous deposit permits the pus, as soon as it is formed in any considerable quantity, to spread widely, and by destroying the cellular connection of the skin to the subjacent tissues, leads inevitably to its devitalization; but in the early stages of suppurative action, the pus is deposited everywhere through the cellular tissue, yet at no point in sufficient quantity, perhaps, to be indicated by fluctuation; possibly its presence may be recognized by a certain quaggy feel; but inasmuch as something is generally gained by the relief of tension afforded by incisions, the surgeon is in very little danger of making his incisions too soon.

The **constitutional treatment** has already in some measure been anticipated in the recommendation of general preventive hygienic measures. The same measures are equally important therapeutically. Patients suffering under erysipelas demand first of all an abundant supply of pure air. Nutrition, also, is of primary importance; but unfortunately, in a pretty large proportion of cases, the presence of acrid and unwholesome ingesta in the stomach and alimentary canal render it necessary to precede the attempts at alimentation by a single brisk cathartic. It must be well understood, however, that evacuation, and not depletion, is the end to be attained; and that, after the first efficient evacuation, it will be only required to secure, by the aid of mild aperients, or otherwise, one movement of the bowels daily.

Nutrition must be sustained by animal broths, eggs, milk, and such other articles of food as are easy of digestion, and at the same time best adapted to the supply of textural waste.

Stimulants, such as wine, ale, porter, and milk punch, are to be given cautiously. They are properly only aids to alimentation; and if the stomach is burdened by them, or the general system unduly excited, their legitimate purpose is not only defeated, but they do harm.

There are, however, certain conditions of extreme exhaustion in this disease, as probably there are in all other diseases, in which, as the exception, stimulants may be employed in larger quantities for the purpose of sustaining an artificial action of the vital forces, until nutrients, which enter the system more slowly, can have time to accomplish the necessary repairs. They act in such cases as temporary buoys, but they cannot be trusted to keep the vessel afloat long.

As a tonic, we can recommend quinine with the tincture of the sesquichloride of iron, according to the following formula:—℞. Quiniæ sulph., gr. xxxii.; tr. ferri sesquichlor., f ʒ i.; aquæ f ℥ iv. M. Of which one teaspoonful may be given every four hours, in water.

CHAPTER II.

ABSCESS.

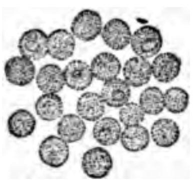
Syn.—Abscessus, (R. C.)

Suppuration constitutes one of the so-called "terminations" of inflammation.

What is known among surgeons as healthy or "laudable" pus, is a compound substance, composed of pus globules and serum. In this crude state, as seen on the surface of healthy wounds, it is a light cream-colored fluid, inodorous, heavier than water, having a specific gravity of from 1·021 to 1·040, insoluble in water, coagulable by alcohol, hydrochlorate of ammonia, and by heat. It undergoes putrefaction very slowly.

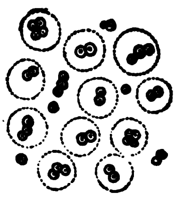
Pus globules are by most pathologists now declared to be wandering cells, microscopically and chemically identical with the white corpuscles of the blood, with lymph and with chyle corpuscles. They have received, therefore, the common appellation of leucocytes. These globules are spherical or ovoid, varying from $\frac{1}{200}$ to $\frac{1}{300}$ of a line in diameter. They have generally been described as consisting of an outer wall or cell membrane, enclosing one or more nuclei, oil globules, and minute granules; but the existence of a defined cell wall has lately been denied, and their precise construction may therefore be said to be at present undetermined.

Fig. 1.



Pus corpuscles, Bennett.

Fig 2.



Same, after addition of acetic acid, Bennett.

Treated with water under the microscope they absorb a portion, and become larger and more transparent. Treated with acetic acid they become still more transparent, and the nuclei are rendered more distinct.

The serum is composed of a large number of elements; some of which are not invariably present, and all of which are unequal in their relative proportions in different specimens; these differences depending upon the varying conditions under which the pus is formed. Chemical analysis and microscopical observations have determined the presence of water, and of mineral salts, such as the chloride of sodium, or common salt, the phosphates and the sulphates; of fat, cholesterin, pyin, and albumen; sometimes there are present small portions of fibrin, globules of blood, and molecular granules.

Among the earlier opinions entertained as to the source of pus corpuscles, we may enumerate the doctrines which ascribed their production to a disintegration or dissolution of the solids, to decomposition of the serum, and to changes in the coagulating lymph; and still later, to secretion, the vessels of the part inflamed being supposed to assume an action analogous to that of the glandular system, causing thus a morbid secretion. This latter theory, suggested first by Simpson in 1722, received an apparent confirmation in the observations of Gendrin, who discovered within the capillaries of an inflamed tissue white corpuscles resembling pus globules. Subsequently, it having been ascertained that these white corpuscles constituted an invariable element of normal blood, a new theory arose, which theory is in fact now generally accepted, namely, that pus corpuscles are merely extravasated colorless blood-cells, which have escaped by a species of endosmosis.

Rokitansky taught that pus was an albuminous exudate, out of which, like other elementary bodies, the pus-cell is developed by virtue of a specific conversion, but that it is never developed out of or at the expense of fibrin-exudate.

Virchow, author of the celebrated doctrine *omnis cellula e cellulis*, recognizes in the pus corpuscles neither a vital secretion, nor a dissolution of structure, nor a metamorphosis of plasma, but only imperfect development, an aborted or immature cell growth, the result of precipitous action; and which, while it was designed to fulfil the purposes of growth and repair, has fallen short of its function, and is rejected. Furthermore, he observes that these imperfect cell growths are the product, exclusively, of the connective tissue; that is to say, pus is formed at the expense of the connective tissue alone.

The question whether pus is ever absorbed and carried into the circulation, is intimately connected with the doctrine of its formation.

We may state that it is now pretty generally believed that pus corpuscles, as such, are never absorbed; but that after undergoing certain changes, presently to be described, all the elements composing pus may return to the circulation; yet examples of the spontaneous disappearance of purulent collections by disintegration and absorption are certainly very rare. Its absorption is effected in the following manner: first, the serum and salts, constituting the most fluid parts, are removed;

second, the pus corpuscles undergo fatty degeneration and disintegration; finally, the pus corpuscles, thus metamorphosed and fluidified, are absorbed also. In other cases the serum alone is absorbed, and the salts, with the desiccated pus corpuscles, remain; the pus corpuscles, when thus separated from the serum, dried and aggregated, forming a cheesy mass, resembling very much tubercular deposits; the salts when not absorbed remaining as cretaceous layers or nodules.

Pus may form upon the free surface, or within a circumscribed cavity. In the latter case it is termed an abscess.

Acute Abscess.

When pus is formed within the parenchyma of an organ, or in a shut cavity, as the result of acute inflammation, it is termed an acute abscess. The symptoms which precede its occurrence are, therefore, the symptoms of inflammation.

The actual occurrence of suppuration is indicated by a subsidence of the pain and of the general febrile disturbance. The pain is not only abated in severity, but it becomes less acute, and is converted into a sensation of weight and tension. When the pus has formed near the surface the inflammatory tumor becomes more pointed, and fluctuates or feels soft under pressure made by the finger, while the base of the swelling for a time increases in hardness. As the matter approaches the surface the apex loses its intense red color, a small vesication usually occurs beneath the cuticle, and finally the cutis is perforated by a minute round hole, which is afterwards rapidly enlarged by the progress of the ulcerative action. In some cases the pressure of the matter strangulates the superincumbent tissues to such a degree that an actual slough is formed, and the abscess is evacuated more suddenly.

In the case of a large abscess, whether acute or chronic, the formation of matter is frequently announced by a chill; and sometimes by several successive chills occurring at irregular intervals. These chills are more apt to occur in persons of a nervous, delicate constitution, but especially when matter forms in certain organs having extensive vital sympathies, as, for example, in the ovaries, in the liver, and kidneys.

When pus forms remote from the surface, and beyond the reach of sight or touch, the subsidence of the general fever, the change in the character of the pain, the chills, and sometimes the copious sweats constitute our sole means of diagnosis.

Treatment.—Pus, having formed within the interior of the body, tends to approach the surface, but when certain structures are interposed, such as bones, tendons, or fasciæ, it may be turned aside and compelled into other routes. In whatever direction pus travels, if the system is in an average condition of health, it seldom penetrates the periosteum and perforates the bone when its source is superficial to these structures; nor does it usually sever tendons, blood-vessels, or nerves; nor is it disposed to empty itself into shut cavities, such as the cavities of the pleura or peritonæum; but its progress is preceded by what might be represented as a solid cylinder of adhesive inflammation, through the centre of which, in a safe but often somewhat devious course, it advances to its destination. When pus forms with great rapidity, or in systems greatly enfeebled by disease, the abscess may not be limited or preceded by adhesive inflammation, consequently the pus may infiltrate the areolar and other tissues in every direction; and by rapid disintegration of the structures with which it comes in contact, arteries and veins may be divided, the bone exposed, and shut cavities laid open.

Acute abscesses, lying near the surface, may be permitted to open spontaneously, provided they evince a disposition to approach the surface rapidly, and they do not occur upon a portion of the body where it is desirable to avoid a scar; but when situated more deeply, especially when the collection of matter is beneath broad, dense fasciæ, if we would avoid extensive dissection of the tissues, the abscess should be opened early, provided always it is safe or practicable to do so. In case a doubt remains as to whether pus has formed or not, before proceeding to use the knife a careful exploration should be made with the needle or with the trocar and canula.

Acute abscesses should be opened freely, so that the matter may escape at once and without obstruction; and, if possible, at such a point as will permit it to continue to flow without the aid of bandages or pressure. We cannot too severely reprobate the practice of thrusting out the matter from abscesses by violence; in consequence of which inflammation is reawakened and suppuration is increased; or the interior becomes filled with blood, which by decomposition becomes in its turn a source of inflammation and often of pyæmic poisoning.

When for any reason it is not thought prudent or proper to open a superficial abscess, it must be treated by rest, poultices, and fomentations.

Chronic Abscess.

Chronic or **cold abscesses** occur almost exclusively in persons of feeble constitutions, and especially in persons of a strumous habit. In a large proportion of cases they originate in some disease of the bone. They are usually accompanied with a low grade of inflammation, the progress of which toward suppuration is often rapid, but at the same time insidious. Not unfrequently large collections of pus are found where no special local mischief had been suspected. Even when they form near the surface, there may be such a complete absence of all the usual signs of inflammation that the surgeon may remain in doubt as to the character of the intumescence until it is revealed by exploration. Sometimes, however, their inception and progress is attended with irreg ular chills, copious perspirations, fever, and all the usual signs of hectic.

Abscesses of this character, which have existed a long time, have usually walls composed of well-organized membranous structure, which is probably formed in great part by the eccentric pressure of the contained matter, and the consequent condensation of the adjacent areolar tissue. These walls are supposed to possess powers of absorption and secretion, and they have been called pyogenic membranes. The contents are usually less consistent than the contents of an acute abscess, owing to the preponderance of serum. They also often contain loose flakes of lymph and coagulated albumen.

Treatment—The treatment of chronic abscess is chiefly constitutional, the indication being to remove the general condition or peculiar cachexy upon which its existence mainly depends. It is unnecessary to say, however, that when a condition of caries or of necrosis of the bone is found to coexist, its removal may be demanded as precedent to all other therapeutical or surgical considerations. Unfortunately, in a large proportion of these cases, as for example when the abscess originates in caries of the spine, this is impossible.

The question of the propriety of opening these abscesses has led to much discussion. There has been equal difference of opinion, also, as to the time and manner of opening them. These differences of opinion have grown chiefly out of the attempt to establish general or universal rules for cases which present such a great variety of characters, depending upon the condition of the general system, the precise nature of the cause, the seat or source of the abscess, its size, and its immediate effects upon the system. The sudden evacuation of a large abscess is sometimes followed by intense irritative fever, which occasionally proves fatal in a few days. In other cases no such results ensue. Precisely in what class of cases it will be proper then to make a free and prompt incision, and in what cases it will be best to delay, or to allow the matter to escape by small and repeated incisions, by valvular incisions, or by the application of caustics, must be left in a great measure to the judgment of the surgeon. As far as possible I shall attempt to aid the judgment of the inexperienced, when speaking of these abscesses as they occur in certain regions of the body, but I cannot do it here.

CHAPTER III.

ULCERATION.

An ulcer may be defined, a solution of continuity in the soft parts attended with a discharge of matter. The term is usually applied to those examples of solution of continuity in which there is no process of repair, but rather a process of decay. If we restrict the use of the term to the latter condition, it might properly be defined molecular disintegration of the soft parts, in contradistinction to sloughing, which is disintegration in mass. The same pathological condition in bone is called *caries*. Ulceration occurring within a circumscribed cavity gives rise to an abscess.

Ulcers may be divided into **common and specific**. For the present we shall limit ourselves to the study of common ulcers. Specific ulcers will be considered in connection with the various dyscrasiæ from which they originate.

Common ulcers are again divided, for the convenience of classification and of treatment, into healthy and unhealthy.

Healthy ulcers admit of no subdivision. They are characterized by small, red, rather pointed granulations, which are also firm, vascular, and bleed easily. The granulations are equal over the whole surface; and when they have arisen a little above the level of the adjacent skin, the sore is in the most favorable condition for cicatrization. Ulcers do sometimes cicatrize when the granulations are below the surface of the adjacent skin, but always reluctantly and slowly. The surface of the healthy ulcer is covered with that yellowish, cream-like matter known as healthy pus, and which the old writers termed "laudable."

Gradually a thin, and at first bluish-white pellicle forms around the margins of the ulcer, which is the new skin extending from the old over the granulations, now reduced again to the level of the old skin. In some cases, and especially when the ulcer has been occasioned by an extensive burn, patches of new skin may be seen to form at various points of the centre, which at length unite with the skin coming from the periphery. This does not happen, however, unless some vestige of the original epithelium remains to constitute the nucleus from which the skin may emanate. Until recently it has been generally taught, that new skin never forms except from old skin; but since the discoveries made by Reverdin and others, we are compelled to modify this statement, and to say that new skin probably never forms except from epithelium cells.

In the ordinary course of events the sore heals or closes over partly by the formation of new skin projected from the circumference of the sore, and partly by contraction of the granulations, in consequence of which latter circumstance the adjacent skin is drawn inward toward the centre of the ulcer. In many cases the cicatrization is chiefly effected by the contraction of the granulations, so that the resulting cicatrix is often exceedingly small in proportion to the size of the original lesion.

The doctrine above stated, that skin never forms *de novo*, is generally accepted by surgeons and pathologists, but so long ago as 1848 I had occasion to express a doubt as to whether exceptions did not now and then occur. A man named Moyer was admitted to the Buffalo Hospital of the Sisters of Charity, having a large and deep sloughing ulcer upon the front of his tibia. When the sore had been cleaned out the bone was exposed quite extensively, and the surface soon became white and dry. In this condition it remained from day to day until at length I observed forming upon the centre a white pithy substance or membrane, which felt soft to the touch; this membrane gradually became more dense, extending itself in every direction, until finally it united with the skin projected from the margin, and the sore was closed over. I considered it an example of skin formed from the periosteum or from the bone. In two or three cases since the date of this observation similar facts have come under my notice. In a paper published in 1851, after referring to these observations, I have described the successful result of an attempt to prevent the sliding of the flap in a plastic operation by attaching the integument to the periosteum.[1] In view of what is now known, I do not feel quite so certain as I did then that these were examples of the formation of skin from bone or periosteum; possibly an epithelium cell was accidentally deposited at these points. Perhaps other observations may hereafter relieve these doubts.

Treatment.—In the case of a strictly healthy ulcer no interference is necessary or proper, except to remove all sources of irritation. Pus is itself innocuous, and only requires to be removed when, from decomposition or from admixture with other matters, its qualities are changed. It is generally sufficient to protect the surface with a piece of lint spread with simple cerate, and to keep the parts at rest. Simple lavements to remove the decomposed matter may also be required once or twice daily.

Unhealthy ulcers may be divided into indolent, irritable, inflamed, and sloughing.

Indolent Ulcers.—Of all the varieties of ulcers, the indolent is the most frequent. We recognize two forms of this ulcer. First, the

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[1] A novel operation made for the restoration of the lower lip, with some remarks on the formation of new skin, by the author. *Buffalo Med. Jour.*, Sept., 1851.

weak fungus ulcer, characterized by profuse spongy, dark-colored, or bright-red granulations, usually denominated "proud flesh," and which is most often seen projecting from the orifices of old sinuses, and especially from such as communicate with bone. The granulations bleed easily, being exceedingly vascular; they are easily destroyed, indicating a low vitality, but they are speedily reproduced. Second, the **indolent ulcer proper**, characterized by broad, flat or rounded, pale, flabby granulations, covered with a pellicle of light gray or white tenacious matter, giving a glazed and shining appearance to the surface as if it were varnished. The edges of these ulcers are smooth, round, elevated, and hard. The parts adjacent are usually tumefied, indurated, or œdematous, and of a pale leaden color. Neither the surface of the sore nor the parts in the vicinity generally possess much sensibility. In a large proportion of cases these ulcers are seen upon the legs.

Treatment.—It will be sufficient in a certain number of these cases to encourage healthy granulation by moderately stimulating applications. For this purpose we apply stimulating collyria, such as weak solutions of nitric acid, of nitrate of silver, of iodine; or, what is much better, stimulating unguents or balsams. The balsams will be found especially useful in nearly all cases of indolent ulcers. Either the balsam of Tolu or the balsam of copaiba, diluted by two or three parts of sweet oil, may be poured upon the surface, then covered over with a piece of sheet lint and bound in place with a few turns of the roller. Iodoform sprinkled over the surface is also an excellent application. Hot water fomentations will often encourage a rapid granulation.

In other cases these simple measures prove insufficient, owing chiefly to the induration of the margins of the sore. A variety of expedients has been found useful under such circumstances. A blister made to cover the whole surface of the sore, including its margins and some of the adjacent skin, may accomplish the purpose of arousing the granulations and of encouraging cicatrization. Nitrate of silver, kali purum, nitric acid, and the other caustics applied to the indurated margins will often prove sufficient; or we may cut away the margins with the knife. Thorough scarification of the margins, and of the whole ulcerated surface, is sometimes practised with advantage.

There is no method, however, which has so generally proved useful in my experience as the application of adhesive strips and a roller, either with or without the aid of the other means above mentioned. In general, also, these ulcers heal quite as rapidly and much more permanently when, the ulcer being thus supported, the patient is permitted to go about and get the benefit of air and of exercise.

That form of the indolent ulcer which we have termed the weak fungus ulcer demands the knife or the caustic for the removal of the excessive granulations; after which it will be treated upon the same principles as other indolent ulcers.

Irritable Ulcers.—Ulcers may assume a character of irritability independent of the amount of inflammation which coexists: indeed, the most irritable ulcers are often unattended with anything like active inflammation. They are most often observed when only the derma is exposed, as by the accidental removal of the cuticle. Not unfrequently, however, they are situated in the deeper structures. The intemperate in eating and drinking are particularly liable, and also those who are suffering under chronic derangement of the digestive functions.

The base of the irritable sore is usually irregular, being made up of concavities of different sizes. In place of granulations there is a white spongy, or perhaps a dark-red mass of tissue which is exquisitely sensitive and bleeds upon the slightest touch. The secretions are thin and serous; or sanious, being mingled with blood-corpuscles; and so acrid as to excoriate the surrounding integuments. The edges are usually undermined and irregular. The neighboring structures are œdematous and sometimes red.

Treatment.—Constitutional treatment is often essential to success in these cases. As local treatment, we employ solutions of opium or of morphine in water, or opium cerates, warm water fomentations, and rest. A single application of some active caustic is occasionally serviceable; but adhesive strips, bandages, and the ordinary stimulating applications invariably aggravate the affection.

Inflamed Ulcers.—An inflamed ulcer is also in most cases a sloughing ulcer. It is at least proper to say that whenever active inflammation is present, disintegration exceeds the limits assigned to ulcerative action, and more or less of the structures disappear in mass. The sore, therefore, presents a mixed character, in which portions of the surface may disclose granulations covered with a thin ichorous fluid, or it may be preternaturally dry, while other portions are covered with gray, brown, or black masses of dead tissue.

The integument adjacent to the ulcer is swollen, red, tense, and shining; while at some distance from its margin the subcutaneous areolar tissue is infiltrated with serum, constituting the condition of "inflammatory œdema." Partly in consequence of the rapid disappearance of the granulations under the combined action of sloughing and ulceration, but mainly in consequence of the tumefaction of the adjacent structures, the ulcer is deep and its edges precipitous.

Treatment.—The suffering structures must be placed at rest, and in such a position that gravity will aid in relieving them from the pressure of the blood. Yeast or charcoal poultices may then be applied. Poultices containing carbolic acid or the chloride of sodium are equally efficacious. In no case will it be proper to apply adhesive strips or bandages: nor is anything gained in these examples of non-specific inflamed sloughing ulcers from the application of caustics.

Whether constitutional treatment will be required or not must be left to the judgment of the surgeon. In most cases the simple measures above indicated are sufficient to accomplish the reduction of the inflammation, and the restoration of the ulcer to a healthy character.

Sloughing Ulcers.—One form of the sloughing ulcer has already been described as being accompanied with inflammation; and it would be unnecessary to refer to the subject again, or to add a new term to the nomenclature of ulcers, except that some ulcers take on the sloughing character independent of the action of inflammation, or, to say the least, when the inflammatory action is by no means a conspicuous or predominating symptom.

This occurs usually in certain low and depraved conditions of the general system. The margins of the sore may be in these cases somewhat elevated and even indurated, or possibly œdematous, but there are none of the appearances characteristic of acute inflammation described as belonging to the preceding variety. The surface is usually free from discharge and the edges are livid, or present small vesications which indicate the commencement of a rapid and destructive disintegration. A low irritative fever usually accompanies these local manifestations.

Treatment.—As local treatment we employ the same remedies as in the preceding variety. In some cases, however, we derive benefit from the application of strong solutions of bromine, as in hospital gangrene, or of nitric acid, after which the sore may be treated with the balsamic or terebinthinate oils or unguents. The unguentum resinæ I have found especially useful. We may also use with advantage the powdered iodoform; or, as recently suggested by Dr. MacGuire, of this city, in certain cases of the sloughing ulcer known as *cancrum oris,* the subnitrate of bismuth may be employed with advantage.

The general treatment, which is indeed of most importance, consists in the free use of tonics, stimulants, and nutrients. Porter, port-wine, milk punches, quinine, iron, beef, and eggs represent the class of constitutional remedies proper to be employed.

Healing of Ulcers by Transplantation.

In a report of my clinic at the Dispensary of Geneva Medical College for January, 1847, the case of a lad, fifteen years old, is given, whose leg had been in a great measure stripped of integument eight years before, and the wound had never closed. The report says:—"Dr. Hamilton proposed to the boy a plastic operation, with the view of planting upon the *centre* of the ulcer a piece of new and perfectly healthy skin. He proposes to take this from the calf of the other leg, not intending to cover over the whole sore, but, perhaps, two or three square inches, which he believes will be enough to secure the closure of the whole wound in a short time."[1]

This lad did not consent to have me operate, and in 1864 he was still living, and the sore remained open.

My first operation of this kind was made January 21, 1854, upon

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[1] *Buffalo Medical and Surgical Journal,* February, 1847, vol. ii., p. 508.

Horace Driscoll, in the Buffalo Hospital of the Sisters of Charity. Driscoll had lost a large portion of the integument of his leg by the fall of a heavy stone upon it; and after the lapse of fifteen months it was apparent that the ordinary processes of Nature were insufficient for its repair. A full account of this operation was published in the *New York Journal of Medicine* for the same year.[1]

The integument was taken from the calf of the opposite leg, but was wholly inadequate to cover the entire sore. In ninety days cicatrization was complete, and it has remained so until the present day, or until a recent date, when I last heard from him. In the result it was observed that the new piece of skin had grown from its circumference in every direction, so that it was in the end nearly twice its original size.

In the paper referred to, occur the following remarks:—"By this means I hope, gentlemen, not only to supply an amount of skin equal to the size of the piece transferred, but to furnish also a nucleus from which additional skin shall be formed. I hope to establish a new centre of life—an oasis—from whose outer verge a true and healthy vegetation shall advance in every direction over the exhausted soil."

I further stated that the graft would not only grow, but that it would also expand centrifugally by the contraction of the surrounding granulations, as by the contraction of the granulations the skin about the ulcer is known to be drawn centripetally; and in confirmation of this also, I referred to the case above described. The following summary closed my remarks:—

"1. Ulcers, accompanied with extensive loss of integument, do generally refuse to heal, whatever may be the health of the body or of the limb.

"2. Anaplasty will succeed sometimes in accomplishing a permanent cure, and especially when the health of the body and of the limb is perfect, and when, by inference, the refusal to heal is alone attributable to the extent of the tegumentary loss.

"3. The graft must be brought from a part quite remote; generally from the opposite limb or from another person" (because in no other way could the graft, with its pedicle attached according to my method, be carried to the centre of the ulcer).

"4. If smaller than the chasm which it is intended to fill, the graft will grow, or project from itself new skin to supply the deficiency.

"5. It is not improbable that the graft will *expand*, during the process of cicatrization at its margins, but especially for a time after the cicatrization is consummated." (This proposition I have since fully verified.)

"6. In consequence of one or both of these two latter circumstances, it will not be necessary to make the graft so large as the deficiency it is intended to supply."

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[1] Old Ulcers Treated by Anaplasty. Read before the Buffalo Medical Association, June 27, 1854, by Frank H. Hamilton, Professor of Surgery in the University of Buffalo, and Surgeon to the Buffalo Hospital of the Sisters of Charity. *Buffalo Med. Jour.*, Vol. X., p. 435.

In reply to Dr. Watson, of New York, who had said that anaplasty for the cure of old ulcers was not new, and that he had done the same himself, I answered in the number of the *New York Journal of Medicine* for January, 1855, that he had only repeated a very old operation of sliding in integument, and one which I had often made myself, long before my new suggestion was announced. "He has never yet thought of making the flap smaller than the space which it is intended to supply, and then trusting to growth and expansion to complete the cure . . . He has not, therefore, adopted my procedure, nor obtained my results."

Since the date of my first operation, I have repeated the operation many times, and with almost uniform success. In 1871, at Bellevue Hospital, Dr. Gouley carried the operation a step farther than myself by applying it for the cure of an extensive burn of the *thigh.* Before operating, Dr. Gouley requested me to see the case with him, and to give an opinion as to whether my operation would succeed. I assured him that if he could engraft only a small piece upon the centre of the immense ulcer, success would be almost certain; but that, inasmuch as he must take the skin from the opposite thigh, I had some fears that he would lose the graft. It would be more difficult than in the case of the leg, to so cross the limbs that the pediculated graft could be attached to the centre of the sore. Dr. Gouley made the operation; and, although only a very small piece was saved, the success of the operation has been nearly or quite complete.

In December, 1869, M. Reverdin, *interne* at La Charité, read before the Surgical Society of Paris a paper on Epidermic Grafting, which was published in the bulletin of the Society for that year, and also in the *Gazette des Hôpitaux* for January 11 and 22, 1870.

The method proposed and practised by M. Reverdin consists in detaching, with the scissors or with the knife, a minute piece of skin, the smaller the better, it is affirmed, and then burying it in the centre of the granulating ulcer; by which simple process a new centre of growth is established, and the sore is healed. The attention of American surgeons was first drawn to this interesting discovery by the experiments of Mr. Pollock, at St. George's Hospital, in May, 1870; and in the following August I commenced a series of observations in the same direction at the Charity Hospital, Blackwell's Island, where we have constantly under our care many hundreds of old ulcers. The results of my first experiments were given to the public by my house-surgeon, Dr. Williams.[1] Of fifty transplantations made either by myself or by Dr. Williams, only six were successful—the great disproportion of failures being due to the almost indiscriminate selection of cases, and to the great variety of methods which we adopted, our purpose being to determine the extent of its applicability, and to ascertain in what manner success would be most certainly attained. Since the date of these operations I have seldom met with a failure, except in those cases in which a failure has been predicted from the unfavorable aspect of the sore, or the instructions in relation to management have not been fully carried out. The following remarks comprise the results of the observations hitherto made, and in which nearly all observers concur:—

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[1] **Healing Ulcers by Transplantation By H. R. Williams, M.D., late House Surgeon, Charity Hospital.**—*Medical Gazette*, **December 3, 1870**

The more healthy the condition of the granulations the better is the chance of success; indeed, with perfectly healthy granulations success is almost certain. It is not material from what point of the body the graft is taken, although it will be found most convenient to take it from some portion which is thin and flexible. With a pair of fine mouse-toothed forceps the integument is lifted, and with the knife or scissors cut out. It is generally considered essential that the areolar tissue and fat should not be included in the graft: whether this is a matter of consequence or not I am unable to say; but it is certain that it makes no difference how small the piece may be, and it is not necessary to cut so deep as to draw blood. Having cut out a piece as small as can be conveniently removed, we may proceed to divide it into several smaller pieces, nor does the amount of contusion which it suffers in this process seem to affect its vitality. After a trial of several methods of inserting the fragments, I have arrived at the conclusion, that if the granulations are fresh and vigorous, there is no better way than simply to lay them upon the surface without attempting to imbed them by incisions, nor does it seem to be a matter of any consequence how they lie, whether with the raw surface turned in one direction or the other. The grafts, when several are inserted simultaneously, should be placed at intervals of about one inch apart, as it is observed that the limit of growth of each separate piece does not in general exceed a diameter of one inch or thereabout. In order to retain them in place, I have generally used common adhesive plaster, reinforced by a few turns of the roller. If the operation of grafting is made upon the lower extremities, it will be necessary to impose upon the patient absolute rest in the recumbent posture.

The dressings should be permitted to remain undisturbed two or three days, when they may be removed, and the sore made clean with tepid water and soap, and subsequently bathed with a very weak solution of carbolic acid and water. The subsequent treatment will be the same as for an ulcer under ordinary circumstances.

When the dressings are first removed, what appear to be the grafts may be seen lying where they were originally placed, or floating loosely about. Sometimes they have disappeared altogether. It is thought that these points, which seem to be the grafts, are only the cuticle which has been sloughed off from the derma. When they remain attached, the process of development of new skin cannot be observed so accurately; but when they have floated away from their original position, we shall notice, first, a slight depression where they were deposited, which depression is in some cases substituted for a corresponding elevation a few days later—generally, I think, the point remains depressed; second, on about the seventh or tenth day after the grafting, the centre of the depression or elevation assumes a bluish-white, opaque appearance, precisely like that which I heretofore described as appearing upon exposed bone when skin is beginning to form. By the aid of a glass the increased vascularity, and some degree of opacity, may be detected at an earlier period. This is the commencement of the process of skin-formation.

At the same moment, also, in which we discover that the transplantation has been successful, we shall see, in case a graft is placed within half or three-quarters of an inch of the margin of the ulcer, that skin is projecting from the margin toward the graft in the form of a minute promontory, so that, if I may be permitted to use a figure of speech, a bridge is soon formed in this direction between the island and the mainland; in a few days more the graft is lost in the surrounding integument, and becomes in its turn the outer margin of the greatly-diminished ulcer. Finally, all the grafts coalesce, each contributing an inch or less to the completion of the cicatrization.

Mr. Steele, who has contributed an excellent paper to the elucidation of this subject, is inclined to think that consecutive transplantations are better than numerous simultaneous insertions, and that each series gives fresh life and vigor to the whole surface.[1] I think also more rapid cicatrization is effected when the grafts are inserted not far from the margins of the ulcer.

How far the new skin differs from ordinary cicatricial tissue has not yet been fully determined; but it appears thicker and more elastic, and it is certainly equally capable of resisting all ordinary destructive influences. Like cicatricial tissue, it is devoid of hair-follicles, sebaceous and sweat glands.

Later experiments have shown that success will occasionally attend the employment of much larger pieces than were employed by Reverdin. I have succeeded with grafts of the size of a five and ten cent piece; but portions are pretty certain to slough, and I doubt whether this method possesses any advantages which would justify its substitution for the much less painful and simpler method just described.

Mr. Fiddes, of England, claims to have succeeded equally by scattering upon the open ulcer the epidermis scraped from the surface of the skin with a dull knife. I think I have succeeded by the same method in one case; having previously soaked in warm water a piece of a finger nail, I inserted it into fresh granulations, where it caused the growth of a thick cuticle.

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[1] Clinical Lecture by Charles Steele, Esq., Surgeon to the Bristol Royal Infirmary —*British Medical Journal*, December 10, 1870.

Dr. Howard has found that grafts of muscular tissue encourage the formation of new skin upon the periphery of the sore, very much as do grafts of epithelium.[1]

Finally, to complete the narrative of experiments which have been instituted up to the present time, a graft has been taken from a limb after amputation, and its transplantation has proved successful. Mr. Pollock has failed to generate skin with colored pigment, by transplantation from the negro; but according to the New Orleans *Picayune*, a somewhat doubtful authority in matters of surgery, Dr. Nicholson has succeeded, and his white patient is in imminent danger of becoming black, inasmuch as "above one-third of the arm is already completely negroed."

Various theories have already been suggested in explanation of this wonderful process: the most plausible of which seems to be, that the epithelial cell contained in the graft imparts to the granulations with which it is placed in contact a new and peculiar vital force, by virtue of which they are enabled to construct cells of the same character; in other words, that we have in this experiment an illustration of the doctrine of assimilation. In my original paper on transplantation for healing old ulcers, I stated several objections to this doctrine; but on the whole it appears, in the light of later experiments, less liable to objections than any other yet suggested. Like all the vital processes, however, it is likely to remain for a long time, if not forever, in doubt.

The range of the applicability of M. Reverdin's operation is not limited to the cure of large ulcers. We have already been able to substitute it for the usual forms of anaplasty in the case of contractions from burns and from other causes, by first dividing the tissues freely, and then, when granulations are fully developed, inserting the grafts. In this way I have even succeeded in restoring to position an everted lid. It is equally capable of preventing contractions and deformities of limbs, by its timely interposition. At Bellevue we have covered by the same method exposed stumps, which would otherwise have demanded resection. No doubt, also, further experience will show many additional circumstances under which it will prove useful.

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[1] Howard. *New York Medical Journal*, September, 1871.

CHAPTER IV.

GANGRENE.

Syn.—Gangræna, (R. C.)

SECTION 1.—TRAUMATIC GANGRENE.

THE term "traumatic" gangrene is applied only to those examples of local death which are essentially due to local injuries. All the varieties of gangrene, including dry gangrene, senile gangrene, and hospital grangrene, find often a special provocation or immediate exciting cause in some local injury, but their characteristic phenomena indicate plainly a peculiar and more or less specific origin. We shall see, also, that the *inflammation* resulting from wounds is not the only source of traumatic gangrene, consequently it is not always a result or "termination" of inflammation.

Traumatic gangrene may be divided into immediate, intermediate, and secondary, or that which occurs in the first, second, and third periods after injury.

Immediate traumatic gangrene, or gangrene occurring before reaction takes place, is due in most cases to the severity of the original injury; the contusion or laceration being such that the vitality of the tissues is from the first completely destroyed, or so much lowered that it is impossible that their functions should be restored.

This species of gangrene may in many instances be with certainty prognosticated from the appearance presented by the parts which are injured. More or less of the structures implicated in contused, lacerated, and gunshot wounds die immediately, or in the course of a few hours, and will separate in a few days by the natural process of disintegration to which all dead animal matter, exposed to the action of air and moisture, is subject: the process of separation being expedited and completed finally by the act of suppuration. Gangrene thus produced does not extend beyond the parts originally injured; it is self-limited, and rarely gives the surgeon much anxiety.

The treatment will consist in the application of emollients, hot water fomentations, and disinfectants, in order to render the separation as speedy as possible and to correct the fetor and the acrimony of the discharges.

Gangrene may be occasioned during this early period also by the tightness of a bandage, or by pressure of any kind. In such a case the prognosis and treatment may be easily determined. If death is occurring only at the point where the pressure was made, it will probably not extend farther; but if it is presented in the limb below or above this point, it may threaten the destruction of the entire limb, and may demand, sooner or later, the interposition of an amputation to save the life of the patient or to insure the formation of a proper stump.

Extensive extravasations of blood or of blood and serum, within the sheaths of muscles, under aponeurotic fasciæ, or immediately subjacent to the skin, obstructing by their pressure venous, arterial, and even nervous circulation, cause the strangulation and death of the parts in a manner similar to pressure from without; and there are many examples in which long and deep incisions at this period are demanded to arrest a gangrene already commenced and due to these causes alone.

Finally, an immediate or primary gangrene may occur, in part from the severity of the local injury, and in part from the great depression of the vital forces of the whole system; as, for example, while the patient is still laboring under shock. In such cases the gangrene must be regarded, generally, as a fatal indication. If the patient is saved, it will not be by local applications alone, but by the liberal use of internal stimulants and nutritious food.

In the **second, or intermediate period**, if gangrene occurs, it is due, in most cases, indirectly to the violence of the inflammatory action. I say indirectly, because it is probable that inflammation causes death in a part only by increasing the effusions, the tumefaction, and the tension of the tissues. It is death by strangulation; and does not differ essentially from death occurring in the first period as a result of effusions, except in this, that the congestions and strangulations are now mainly caused by the inflammation.

Unless we adopt this view of the subject, we shall not understand the value and importance of free incisions as a means of relief, and especially as a means of prevention. When death from inflammation is about to occur, the pain rapidly subsides, indicating an abatement or abolition of the nervous sensibility of the parts. Incisions made a few hours earlier might possibly have prevented this result, but now they will scarcely restore to vitality those structures whose sensation is lost.

It is not improbable, however, that they may prevent the extension of death to some of those structures not yet completely strangulated. Examples are of frequent occurrence in which gangrene, progressing with inflammation, is arrested by deep and long incisions; and the only barrier to the more universal use of the knife under these circumstances, is the danger of wounding important blood-vessels and nerves; and we might add that almost the only limit to its value is found in the fact that the effusions of fibrin possess that degree of solidity, and have so far imprisoned the other effusions by sealing up the tissues, that it is impossible to make the incisions sufficiently free to render the unbridling complete.

It frequently happens in these unfortunate cases, that the progress of the death cases spontaneously when all those tissues which were suffering the most acute congestion have sloughed; and when we are afraid to use the knife we await anxiously the result of this natural process of *débridement.*

When sphacelation occurs the vigor of the inflammation usually subsides, even in those parts considerably remote from the point of sphacelation; and the febrile symptoms assume in general a more typhoid character. We do not pretend to explain this fact. Perhaps it is due to a nervous exhaustion or depletion, consequent upon the destruction of those nervous filaments which are involved in the slough, and which exhaustion may extend its influence to the great nervous centres; the effect resembling what is termed the "shock" of injuries. Other explanations may be offered, but we desire only to notice the fact that the inflammation abates, and in itself is not hereafter a controlling indication of treatment. It is true that the parts inflamed may continue still to perish in some degree from inflammatory action, because it will now happen that a much lower grade of inflammation will suffice to accomplish the same result, but the depressed condition of the general system is hereafter the predisposing and the most active cause. We are now compelled to substitute stimulating for depressing agents, both as internal and external remedies. Wine, brandy, and nutritious broths must be employed freely as internal remedies; and, what is not so easy to comprehend, but all experience has united to confirm, the local applications must be changed from cold to warm or hot, and stimulating. Inflammations of low grades are, with few exceptions, best controlled by such agents as usually aggravate acute inflammations in healthy systems. Cataplasms containing yeast, carbolic acid, the chlorides, the bromides, and the terebinthinate oils, represent the class of local remedies appropriate for inflammatory traumatic gangrene.

A new danger is also from this moment added to those which previously existed. The disintegrating animal structures in a state of partial solution contain an active poison, which taints the living tissues upon which it reposes; and which, so long as it continues to bathe the open mouths of the veins and absorbents, is liable to be taken into the circulation, causing septicæmia, or at least to excite in them an irritation capable of being propagated to every part of the body into which these vessels ramify.

In order to combat these dangers it is necessary not only to employ freely the antiseptics above mentioned, but also in every possible way to hasten the separation and removal of the dead and decomposing tissues. This we seek to accomplish by poultices and lavements, and by clipping away all loose and hanging fillets.

Gangrene occurring in the third period, or after suppuration is established, indicates usually a renewal of the local inflammatory action in consequence of the intervention of a new source of irritation; or, as happens more often, it indicates a serious decay in the vital forces of the general system, and is therefore a fatal symptom.

The question of amputation arising during the progress of traumatic gangrene, must be answered by a reference to its origin, progress, and the probable causes of its continued extension. If dependent solely upon constitutional causes, amputation can be of no service. If dependent upon local causes which have ceased to operate, it will probably cease spontaneously, and amputation is unnecessary. If dependent upon local causes which continue to act, and whose removal can be effected by no other means, amputation is the remedy. To this latter class belong some of those examples in which the presence of disorganizing tissues is plainly infecting the general system and causing local death by contact, but in which sufficient health still remains to endure the shock of an operation. To recognize and appreciate the value of all these conditions demands on the part of the surgeon the greatest exercise of judgment; but so seldom do the most experienced surgeons attain the amount of discrimination requisite to make a proper selection, that it has happened, in a large majority of cases where amputations were made for progressive gangrene, the patients have not recovered; and in fact the fatal event seems to have been thereby hastened.

SECTION 2.—GANGRENE FROM INSUFFICIENT SUPPLY OF ARTERIAL BLOOD, USUALLY DENOMINATED SPONTANEOUS GANGRENE.

Under this division of our subject we include gangrene occurring as a consequence of the ligation of an artery, as happens occasionally after the application of a ligature for the cure of an aneurism; gangrene from digital or instrumental pressure made for the cure of an aneurism; from the pressure of the aneurismal tumor itself; from the pressure of other tumors; gangrene caused by the projection of dislocated or broken bones against arterial trunks; gangrene caused by embolism; by thrombosis; by arteritis; by atheroma and calcification of arteries; by feeble action of the heart, as in cardiac diseases, and in certain low forms of fever; by the sudden abstraction of large amounts of blood from the general circulation; by contraction of the extreme arteries, as in ergotism; by scorbutus.

Only a few of these forms of gangrene will demand a special consideration.

Embolism. Syn.—Embolus, (R. C.)

A small fibrinous clot, which has originally formed in an aneurismal sac, or perhaps in the left ventricle of the heart, as a consequence of endocarditis, becoming detached, is conveyed through the larger arterial trunks, until at some point of bifurcation, or having entered a branch too small to permit its passage, it is arrested. This constitutes an embolus.

Modern researches seem to point to embolism as a very frequent cause of paralysis of function, metastatic abscesses, and of fatal disorganization in various organs of the body; but in a surgical point of view we are chiefly interested in those examples in which the embolus causes obstructions of the arteries of the extremities. Usually it is the femoral or popliteal artery which has received the fatal clot. In some cases the patient has been conscious at the moment of a peculiar sensation as the clot escaped from the heart and passed to its destination, and he has been able to indicate the point at which it was finally arrested. This has usually succeeded some violent effort, as in straining at stool, in child-birth, or in lifting.

The limb is soon affected by a sense of weight, pressure and pain, accompanied with numbness, and loss of muscular power. More or less speedily, also, according to the degree of obstruction, the extremity assumes a purple or mottled color, becomes œdematous, vesicated, and sloughing takes place. Usually the gangrene is of the moist variety, owing to the suddenness with which the circulation has been interrupted, and the consequent presence in the limb at the time of its death of a large amount of blood and other fluids. In other cases the toes first become black, dry, and shrivelled, as in other examples of dry gangrene.

Treatment.—Amputation is about the only resource; but before deciding upon this the surgeon must ascertain satisfactorily the point of obstruction, in order that the knife may be applied between the embolus and the body. He must also convince himself that the action of the heart and the condition of the general system encourage a hope that the patient can successfully rally from so grave an operation. Unfortunately, in a majority of cases, valvular or other forms of cardiac disease constitute the source, and continue as complications of these serious accidents; and the force of the heart is neither sufficient to establish anastomotic circulation at the seat of obstruction, or to enable the patient to recover from the shock of an amputation.

In June, 1876, I had in my wards at Bellevue a case of embolism of the right leg occurring in a woman 37 years old, which terminated in gangrene, and a spontaneous separation at the knee-joint about ten weeks after the occurrence of the embolism. She made a complete recovery. In some cases the obstruction is removed by the force of the arterial current sufficiently early to prevent the occurrence of gangrene, and no serious or permanent results ensue.

Thrombosis, (R. C.)

A local coagulation, or the formation of a clot at the point of obstruction, is termed thrombosis. In consequence of the presence of an atheromatous deposit upon the interior of the artery, and which is peculiarly apt to occur in the later periods of life at the points of bifurcation of the large arteries, the fibrin of the blood becomes entangled, and separated from the current, forming after a time, but much more gradually than in most cases of embolism, a fibrinous clot.

The most important practical distinctions between embolism and thrombosis as affecting the extremities are, that the former may occur at any period of life, while the latter is almost confined to advanced life; the former is in most cases due to cardiac disease, occasionally to the presence of an aneurism, while the latter is generally due to atheroma, sometimes to local arteritis; the former has occasionally been recognized at the moment of its occurrence by certain peculiar sensations, its progress is usually rapid, and its termination generally fatal; the latter gives no premonition of its occurrence, its progress is relatively slow, giving time sometimes for the establishment of a feeble anastomotic circulation, and it presents, therefore, a better opportunity for conservative and therapeutic treatment.

Amputation as a final resort, in these cases, has occasionally been successful.

Senile Gangrene. Syn.—Gangræna Senilis, (R. C.)

This term is employed, in obedience to the general custom of surgical writers, to indicate those varieties of gangrene which depend chiefly for their origin upon conditions peculiar to old age.

These conditions are essentially calcification of the muscular coats of the extreme arteries, united probably in most cases with a feeble action of the heart, and with more or less atheroma of the larger vessels. Feeble action of the heart alone is competent to the production of a similar condition, as we find illustrated in those examples which succeed low fevers, or copious bleedings. It may be caused by the internal use of ergot, as will hereafter be explained, and probably in other ways. Again, in advanced life atheroma of the larger trunks occasionally leads to thrombosis in the manner described in the preceding section, but in this case the gangrene is more acute, and more diffused than in the case of the variety now under consideration, and it is not usual to classify its phenomena with those belonging to senile gangrene proper.

There are several ways in which senile gangrene may be announced.

First, a small black or purplish spot may be observed, most often upon the inside or end of the great toe, perhaps unaccompanied with pain, or with any signs of inflammation, unless there be present a slight areolar blush bordering the margins of the discolored spot. In this case at first, and during a large portion of the progress of the affection, the dead tissues, in consequence of a lack of fluids, do not disintegrate, but become dried and mummified like a piece of dried beef. When the parts are in this condition it is termed "dry gangrene."

Second, and very rarely, examples of senile gangrene have been reported, in which the local death was announced by a white and shrivelled spot. I have seen gangrene of the toes commence in this manner in one case, where it was caused by the pressure of a fragment of bone upon the popliteal artery, while at the same time the foot was kept elevated; and in a second example a white, shrivelled, and insensible spot upon the front of the leg announced the commencement of gangrene after

I had tied the femoral artery for a traumatic aneurism. It has not happened to me, however, to see senile gangrene commence in this manner.

Third, the occurrence of gangrene, unaccompanied with any recognized local provocation, may be preceded by pain, some swelling, and vesications, and in such cases the local death results usually, yet not always, in speedy disintegration, constituting a variety of "moist gangrene."

Fourth, senile gangrene, presenting all the features belonging to the third variety, may be preceded by some slight injury, such as the chafing of a tight boot, causing, perhaps, a superficial excoriation; and in its early stages it may scarcely be distinguished from such a moderate erysipelatous inflammation as often results from similar accidents at all periods of life.

In whatever manner the gangrene commences, after it has fairly set in, the parts in the vicinity become mottled, purple, and red; and dusky red lines are seen sooner or later extending up the limb. The pain also becomes acute, and is accompanied with a sense of heat or of burning in the parts. Sometimes the neighboring lymphatic glands enlarge. The general system is in the progress of the malady considerably disturbed, causing great restlessness and continued watchfulness.

Spontaneous separation may occur after the destruction of a single joint, or of a single toe, or it may not take place until it has reached the ankle or knee-joint. Usually the patient sinks under the protracted irritation, and the septicæmic intoxication, before the gangrene has reached this latter point.

Treatment.—In regard to the local treatment of senile gangrene it would be impossible to establish precise and absolute rules, inasmuch as the local symptoms are found to vary so greatly in different cases. In general it may be stated that warm and moderately stimulating applications afford the most relief to the burning and lancinating pains which so often accompany these affections. The unguentum resinæ, spread upon a piece of thin muslin cloth and overlaid with cotton-batting, forms an excellent dressing. Equal parts of the balsam of Peru with sweet oil, or carbolic acid in the proportions of one drachm to the pint of sweet oil, are equally appropriate. Occasionally, to facilitate the separation of the dead tissues, and especially when the inflammation is more acute, yeast poultices or hot water fomentations are required.

On the other hand, we have every now and then met with cases in which cool water lotions, either with or without the addition of opium, have afforded the most relief.

The general treatment must be in all cases sustaining, and especial care should be taken to encourage digestion. A mixed vegetable and meat diet, with porter or some agreeable stimulant, in moderate quantities, will contribute to this end. If possible, the patient should be permitted to ride in an open carriage daily.

To procure sleep and to alleviate the pains, opium in some form has always been found necessary. Solid opium, McMunn's elixir, or Squibb's liquor compositus are preferable for these purposes to the tincture of opium or to any of the preparations of morphine, in so far as they are less liable to cause nausea and to impair digestion.

Amputation made during the progress of the gangrene is seldom successful. In case, however, it is decided to adopt this expedient as a final alternative, the amputation should be made so high as to render it probable that it is above the point where the arteries have undergone any serious degeneration. Amputations of the leg for senile gangrene of the foot are most often successful when made at or near the knee-joint; indeed, as a rule, experience has shown that the knee-joint ought to be considered the point of election.

Gangrene from the Use of Spurred Rye.

Many years since, M. Tessier, by request of the Royal Society of Medicine of Paris, instituted a series of experiments and observations, which established beyond controversy the fact that ergot was capable of producing a species of dry gangrene, resembling very closely the dry varieties of senile gangrene, and that this fungus was its most common cause in various parts of France, Switzerland, and Germany, where damaged rye was much eaten. Subsequent observations have still further confirmed the statements made by M. Tessier.

The peculiar effect of ergot in the production of gangrene is attributed to its well-known power of causing contraction of the involuntary muscular fibres, and which seems to extend to the extreme vessels of the arterial system.

In the few examples of gangrene from this cause which have come under my notice, the fingers have been more often the seat of the malady than the toes. It has shown also a greater tendency to limit itself by early separation from the sound tissues than is usually observed in cases of senile gangrene.

Gangrene from Scorbutus.

In the month of September, 1862, I was permitted to see in the Armory Square Hospital, at Washington, under the charge of Surgeon Bliss, U.S.V., nine examples of dry gangrene in soldiers belonging to the Army of the Potomac, which were manifestly the result of a scorbutic taint. The men who were thus attacked were all new recruits, and most of them were quite young. They were from the farming districts of New England, and had been in the service only about three months, during which time they had been subjected to no particular hardships either in marching, fighting, or exposures to inclement weather. No fevers or other sickness had preceded the attack. In no instance were the men able to assign any cause; but upon inquiry it was ascertained that during these three months they had been confined almost entirely to either salt or fresh meat, and hard bread.

The gangrene assailed both fingers and toes; and in most of the examples it was arrested after having involved one or two joints. I have been since informed that in no instance did it cause death. The surgeon in charge entertained the same views as myself as to the cause, and they were therefore fed liberally with vegetables and other antiscorbutics.

Among all the cases of scorbutus which came under my notice during the war of the rebellion, and they were very numerous, especially in the Western armies, no other examples of dry gangrene were seen by me; but the condition of these troops was in some respects peculiar. They came from rural districts, and had been all their lives accustomed to an abundance of potatoes and of other vegetables, with milk, butter, fresh bread, etc. The change of diet was therefore greater than soldiers are in most cases subjected to; it was also protracted and unusually sudden.

SECTION 3.—HOSPITAL GANGRENE.

Syn.—Gangræna Nosocomiorum, (R. C.)

The following remarks on hospital gangrene, made by my son, now deceased, while he was Acting Assistant Surgeon, U.S.A., and after he had enjoyed remarkable opportunities for observing the causes, progress, and treatment of the malady, both on the field and in hospital practice, were published originally in my treatise on military surgery. They accord with my own experience, and receive my unqualified endorsement. I trust, therefore, no apology will be required for their introduction into this volume.

Hospital gangrene is the name given to a peculiar form of contagious phagedenic ulceration, whose causes, symptoms, pathology, diagnosis, prognosis, and treatment will form the subject of the present chapter.

Causes.—These are of two classes; namely, general or predisposing, and special or exciting. To briefly describe the former, we should simply mention all infringements of any well-known sanitary law; as including nearly, if not all, of the general influences favorable to the production of this disease. This, of course, comprises all errors in the location, ventilation, and police of institutions devoted to the care of a collection of sick and wounded; for it is only in an aggregation of cases that we ever meet with hospital gangrene.

Although overcrowding, bad ventilation, and want of cleanliness are too frequent causes of this form of phagedæna, still it is a well-known fact that severe and protracted epidemics of the disease have been inaugurated in hospitals whose locations were most healthful, and where all sanitary rules were obeyed with the utmost exactness. Such was the case at the De Camp and McDougall general hospitals, during the summer of 1863, then under the excellent management of Surgeons Simons and Bartholow, U.S.A., respectively.

To the above must be added all those predisposing causes which may exist in the patient himself. For example, a patient with a scorbutic taint, an enfeebled constitution, or a nervous system depressed by the effects of a severe operation, or by the administration of chloroform, would, other things being equal, be more prone to contract hospital gangrene than his more robust comrade. This rule is, however, subject to exceptions, for I have repeatedly seen the disease attack the most healthy among a number of patients, leaving the anæmic and feeble untouched.

Some writers have claimed that certain seasons of the year were more favorable than others to the production of this disease. This statement has, I think, not been sustained by the observation of our army surgeons during the present war. It has prevailed in the hospitals at Nashville, Louisville, Murfreesboro', and elsewhere, at all seasons, and with an intensity more in proportion to the number of patients than to the time of year. For example, during the extreme cold of the winter of 1862–3, hospital gangrene suddenly made its appearance, under my personal observation, at the U.S.A. General Hospital, at Central Park, in this city. I am confident, however, that a very moist atmosphere has an injurious effect upon all suppurating wounds. I have repeatedly seen this illustrated in my wards at the McDougall General Hospital, where, on three different occasions, all the wounds under treatment put on an unhealthy action, many becoming gangrenous simultaneously, or nearly so; this occurrence evidently depending upon protracted periods of wet weather, which existed previous to each appearance of the unhealthy action in the wounds. This fact is easily explained, when we reflect that the probable cause of this form of ulceration is the presence in the air of the products of putrefaction, and that a moist is more favorable than a dry atmosphere to the formation of this material. The fact that we meet with this disease in mid-winter, might seem to conflict with the theory that it is dependent upon the presence of putrefactive material in the atmosphere; this discrepancy, however, is easily explained, when we come to consider that the wards of a hospital may contain in winter air which, heated by artificial means and rendered moist by the exhalations of a damp cellar, or from other sources, may be equally productive of decay in animal tissues, as the air of the hottest summer months. The plant in the hot-house flourishes as well in winter as in summer, provided only the air from which it derives its nourishment is supplied with the necessary warmth and moisture. The patients in our hospitals are rarely exposed to the vicissitudes of the seasons, the air in the wards being carefully equalized at all times. Hence the air which surrounds a patient in winter is often more unwholesome than that which he respires in summer, for the reason that in winter ventilation is frequently omitted, in order to keep the air at a certain temperature; or, in other words, a quantitative analysis of a specimen of air taken from a room containing a number of suppurating wounds in winter, would reveal as large a quantity of the products of putrefaction present, as a similar analysis in the same locality in midsummer, provided that ventilation had been wholly, or even partly, sacrificed to warmth.

We now come to the consideration of the special or exciting causes. Of these, the most important are contagion and infection. No one now doubts that hospital gangrene is contagious. It can be conveyed from one individual to another by inoculation with the same certainty that attends the process of vaccination. Pouteau, a celebrated French surgeon, at that time a dresser at the Hôtel Dieu, accidentally inoculated a scratch upon his finger, while attending a case of this kind. Within a few days the characteristic slough had appeared and was only arrested by the most active measures. The poison adheres with great tenacity to dressings, or other substances, once impregnated. Guthrie relates that some lint which had been used in these cases at Paris was taken to Holland, having been previously thoroughly washed, dried, and bleached. When it came to be used in Holland, it was found to infect every wound or ulcer to which it was applied.

Hospital gangrene may be generated in a wound by reason of the presence of any decomposing coagula or product of inflammation. It may owe its origin to the irritation caused by a spiculum of bone, a shred of lint, or other foreign substance; sudden exposure of the part to excessive cold, a hardened poultice, an acrid lotion, or a direct injury, can often be assigned as the exciting causes of this disease. The indiscriminate use of sponges, basins, and towels is, for obvious reasons, a fruitful source of hospital gangrene.

The disease is infectious; that is to say, it may be communicated from one person to another without the intervention of absolute contact. This fact has been indubitably settled by the evidence of a large number of clinical observations.

In a given case, we shall almost always find one or more of the local, combined with a variable number of the general causes enumerated, concerned in its production.

The type of the disease varies with the number, quality, and intensity of the general causes which are combined to produce and maintain the different epidemics.

The symptoms are both local and constitutional. The former, being by far the more important, will claim our first attention.

Local Symptoms.—Hospital gangrene may attack a wound in any stage of its history, from the day of its receipt to a time when its cicatrix is nearly formed. It may attack an ulcer of any variety, from the highly inflamed ulcer, the result of a burn, to the indolent and intractable sore which we meet with in old and enfeebled patients. It may be the result of inoculation, and it may be generated where, to all appearances, there is no abrasion of even the cuticle.

In all instances, with the exception of the two last mentioned, the local appearances are very nearly uniform, and for the sake of convenience will be described under three classes, namely: those characterizing the periods of invasion, of full development, and of decline, respectively.

When hospital gangrene invades an open wound or sore, it first makes its appearance by dotting the part with blackish-gray points, distributed at intervals over its surface. The healthy secretion of the part is suspended. The edges of the wound are livid, slightly raised, and everted. The lividity of the edges extends a few lines, where it is met by a broad erysipelatous areola, showing capillary congestion and stagnation. There is discharged, at the same time, a small but variable quantity of a thin sanious fluid. The whole part now exhales a very offensive and penetrating odor. The above signs sufficiently characterize the stage of invasion, which occupies a period of from six to twenty-four hours. The grayish spots soon multiply and aggregate, completely covering the part with a pulpy tenacious mass, through which the ichorous fluid is being discharged in small quantities. The edges present a livid and sharply defined appearance. If not of a circular form, the circumference represents a circle with the segments of smaller circles ingrafted upon it. The slough, meeting with less resistance from the loose areolar tissue, burrows under the integuments, leaving, in some instances, a narrow portion only of sound skin bridging the excavation; more often, however, the ulceration extends only to the depth of a few lines beneath the skin, forming pouches, in which the débris of the slough are apt to accumulate. Sometimes the gangrenous slough is projected from the surrounding tissues, presenting the appearance of a fungoid growth. In cases of this variety, however, the mass is soon levelled down by the rapacious ulcer, and presents the usual excavated appearance, unless, as I have seen, the disease be arrested while the slough is still in this position.

When hospital gangrene invades the track of a ball it frequently occasions large excavations underneath the skin and other tissues, out of sight, which will, unless the surgeon is forewarned by experience, escape his observation, until suddenly the skin, which has already become discolored, gives way and reveals an extensive gangrenous cavity, with the tendons, vessels, and nerves, perhaps, cleanly dissected, and stretched across from side to side.

Should it make a successful attack upon the muscular structure, we may see shreds of this fibre eroded and depending from the slough. The mass evolves a penetrating stench, which needs only to be perceived to be recognized. The phagedæna now rapidly extends in all directions, but particularly in the direction of the cellular planes. Thus I have seen the muscles of the lower extremities exposed for a width of four inches, and from the trochanter to the malleolus, as the result of a slough of this character. The disease occasionally extends to the bone itself, producing extensive caries.

A wound presenting these appearances might be said to be in the stage of full development of hospital gangrene. Each new case, however, may present some peculiarities and anomalies in its minute appearances, which are to be learned from experience more than from any description which can be given.

The gangrene now progresses rapidly, unless arrested. I found the average duration of the disease during an epidemic occurring under my observation, to be sixteen days; but it is not to be expected that an average based upon any other set of cases would correspond precisely with this, inasmuch as the disease is not self-limited, and its duration depends entirely upon the success of the treatment adopted.

In case our treatment is successful, the stage of decline is soon ushered in. This is characterized by a sudden and complete evolution of the slough, revealing the bright healthy granulations which rapidly repair the injury; or the surface presented is simply muscular fibre, smooth, red, destitute of covering of any kind, and without secretion or granulation.

When hospital gangrene attacks an unbroken surface it generally appears as a vesicle. This soon breaks, discharges a thin sanious fluid, and leaves a surface covered with the characteristic slough. It is sometimes first noticed as a bluish spot upon the integument. Although differing in their primary appearances, these varieties assume the character of the former and more common class, as soon as there is an open surface exposed. After the slough has once made its appearance, no matter what may have been the character of its origin, the history of its subsequent development is uniform with that which has been described as belonging to the first variety mentioned.

Constitutional Symptoms.—These are in general conceded to be in a great measure dependent upon the local difficulty. They consist chiefly of pain, loss of appetite, great exhaustion, febrile action, diarrhœa, and sometimes delirium. Dr. M. Goldsmith, Surgeon, U.S.V., a gentleman whose experience and research in this disease render his opinion of great weight, makes the following statement as the result of his observations:—"The disease could in no case be said to have a constitutional origin. In no case did the constitutional symptoms precede the local disease, or continue after the gangrene had been arrested." My own experience fully confirms the truth of this observation.

The pain, when present, is described by the sufferer as gnawing and biting, and is sometimes very excruciating.

The patient generally loses his appetite at the outset of the disease, and does not recover it until the sloughing is finally arrested.

Fever is by no means a uniform symptom, but, when noticed, is marked by a frequent thready pulse, insomnia, and sometimes delirium. It always partakes of the asthenic or typhoid type, and demands stimulants and nourishing diet.

Pathology.—There is no certain knowledge in regard to the pathology of hospital gangrene. Clinical observations have pointed to the fact that the malady is, in the first instance, local, and that the constitutional symptoms are in a great measure dependent upon the fact that some part, either of the products of the sloughing process or of the original morbific material, is absorbed or introduced from the affected part into the general system. The occurrence of pyæmia, and the great constitutional disturbances which are the frequent accompaniments of this disease, plainly confirm this observation.

I am convinced that hospital gangrene can be generated, *de novo*, only where there is a number of suppurating wounds in close relation to each other; that under these circumstances, the peculiar poison or fomites is produced. What is the nature of this poison, and upon what it depends for its peculiar power, we are as yet ignorant. Microscopical examinations of the slough reveal the débris of tissues, but no peculiar living organisms. Dr. J. J. Woodward, U.S. Army, writes to the Surgeon-General, that a microscopic examination of the slough failed to reveal "any cryptogamic organisms, except the ordinary vibrios, which are to be observed in every decomposing animal substance."

The pathological relations of hospital gangrene to diphtheria, erysipelas, pyæmia, and gangrenous scarlatina, have been the subject of much research and discussion. The point is, however, far from being settled, and possesses but little value in a practical point of view.

Diagnosis.—Keeping in mind the marked character of the slough, and a few of the more prominent of the local symptoms, we will rarely fail to distinguish hospital gangrene from any of the common forms of phagedenic ulceration or erysipelatous inflammation. The disease has few, if any, of the characteristics of either form of common gangrene, and hence will never be confounded with them.

Prognosis.—In 1787, Pouteau wrote that public hospitals had better be abandoned, inasmuch as the frequent occurrence in them of hospital gangrene had rendered them rather a scourge than a benefit to humanity. In 1813, however, an entire revolution of feeling on this point took place, by reason of the introduction of local caustic applications in the treatment of these cases, by which means they were transformed into comparatively harmless occurrences. I am confident that, if the statistics of all the U.S. Army Hospitals in reference to this disease were to be collected, the mortality shown would be considerably less than five per cent. Such a result would contrast remarkably with the statistics furnished by the campaign on the Spanish Peninsula in 1813, where out of 1,614 cases, 520, or nearly one-third, proved fatal. The treatment relied upon at that time consisted in bloodletting and the administration of mercurials.

Treatment.—The treatment of hospital gangrene naturally divides itself into prophylactic, constitutional, and local.

The prophylactic treatment consists in the avoidance of all the general and specific causes which are known to be in any way concerned in the production of this disease, and in the use of disinfectant agents in the management of any aggregated number of suppurating wounds, a bountiful supply of wholesome air, a rigid system of police, and a nutritious diet.

The proper location of sinks in relation to the hospital wards, and the free use of the chloride of lime or of some other disinfectant in them when they are necessarily placed in close juxtaposition to a ward, are matters also of vital importance.

In the dressing of wounds great care should be exercised to keep them free from any accumulation of pus or of coagulated blood, and to remove immediately to a distance, or, what is better, burn all lint, bandages, or other dressings, as soon as they have been taken off from a suppurating surface. Their presence in the wards, for a few hours only, may be sufficient to produce hospital gangrene. In short, a reference to the enumeration of the general and local causes will give a ready key to the subject of the prophylactic treatment of this disease.

I believe that there is now but one opinion in regard to the means to be adopted in combating the constitutional symptoms presented during the rise, progress, and decline of hospital gangrene. No one now thinks of recommending bleeding, or depletion by any method, or at any stage. Experience has established the rule that the patient must be sustained from the first period of the disease to the last. Wine, porter, and other permanent and diffusible stimulants are generally used, in conjunction with iron, quinia, and beef-tea. As to the quantity and kind of alcoholic stimulants to be given in a certain case, this must be decided by the previous habits, by the taste, and by the inclination of the patient. I have found that strong milk-punch, made either of brandy or whiskey, is by far the most agreeable and efficient mode of administering stimulants in a large majority of cases. In case beef-tea or beef-essence is not relished by the patient, eggs and other nutritious food should be substituted.

We now come to the most important part of the treatment, namely, the local applications. These are many, and vary in simplicity of preparation from the actual cautery to the elegant combinations of the permanganates and bromine. We will not attempt to enumerate the more obsolete of the local applications, but refer more particularly and minutely to those which the clinical experience of comparatively recent dates has proved to be the most efficacious. Nitric acid has been used with some success, both in a pure state and diluted. Creasote, pyroligneous and strong acetic acids have been advised by some Nitrate of silver has sometimes been successful in arresting the progress of the sloughing. My own experience has convinced me of the superiority of bromine over any other preparation as a local application in hospital gangrene. We are indebted to Dr. M. Goldsmith, Surg., U.S.V., for the introduction of this valuable agent. In order to obtain the full and complete effects of bromine, it should be applied carefully and thoroughly. The following practical hints, suggested by Dr. Gold smith, most of which have been confirmed by my own experience, should be observed in the application of this agent:—

1st. If the operation promises to be a painful and tedious one, Dr. Goldsmith advises that the patient be rendered insensible by the use of an anæsthetic. This I consider of doubtful propriety, inasmuch as I regard the depressing influence of chloroform as a predisposing cause of the disease.

2d. The wound, having been carefully cleansed by thorough sponging with warm water and soap, should be freed from all dead and gangrenous tissue by means of a scalpel or scissors, aided by the forceps. The healthy tissue should be denuded as far as possible.

3d. The surface to be treated should now be thoroughly freed from moisture. This is most readily done with a swab of lint on the end of a probe, with which the surface is carefully dried. Do not omit to penetrate the pouches and recesses.

4th. If the pure bromine be used, a small glass pipette should be introduced into the bottle containing the liquid, and then, being carried to the surface to be cauterized, thoroughly applied to every part. Cavities may be reached by means of small portions of lint dipped in the bromine, and then carried by means of an eyéd probe, or a pair of forceps, into the desired positions.

5th. It is frequently beneficial to paint the surrounding tissues to the extent of an inch, perhaps, with a solution of the bromine; using a drachm of the bromine in four ounces of water.

6th. Immediately after the application of the bromine an emollient poultice should be applied. This tends to allay any undue irritation, and favors the speedy evolution of the slough.

There are three different preparations of bromine which have been employed. Dr. Goldsmith first employed a solution of the bromide of potassium and bromine, or the compound solution. After using this for some time, he at length resorted to the pure brominium, and very soon arrived at the conclusion that this was the only form in which it should be used. I have used both the compound solution and the pure bromine, and do not hesitate to express my preference for the latter article. I have also used a dilute solution of the pure bromine, in the proportion of a drachm to eight ounces of water, with great benefit.

as a disinfectant and prophylactic dressing to be applied to unhealthy looking wounds.

After having carefully applied bromine to a case of gangrene, we find that the part smells perfectly sweet and clean. If there is any trace of the odor remaining, we may be sure that our application has not been thorough.

The fumes of bromine, given off as a dense red vapor when a bottle of this liquid is unstoppered, furnish us with an invaluable diffusible deodorizer in wards where the emanations of a large number of suppurating wounds render the atmosphere fetid.

The permanganate of potassa is scarcely inferior as a local application in this disease. Dr. Hinkle, Act. Assist. Sutg. U.S.A., has the honor of having first introduced this valuable agent to the notice of the profession. Dr. Hinkle also recommends that the salt shall be given internally in the form of a solution, giving from one to three grains every twenty-four hours. He attributes to it the power of "a tonic astringent, an oxygenator, and vivifier of the blood." "Locally," I quote his words, "the concentrated solution was applied as an escharotic, with a hair pencil, over the surface of the wound, even extending its application over the cuticle four inches beyond the seat of the wound. After the wound was carefully pencilled, lint, saturated with the dilute solution, was applied, and the dressings repeated every three or four hours." The "permanganate salts," or "disinfectant," is now supplied by the U.S.A. Med. Department. The liquid is of a purplish-black hue, and very dense. The bottle containing the substance is supplied with a label giving full directions for use.

Monsell's solution of the subsulphate of iron has also been recommended, and clinical experience has shown it to be a valuable agent in the treatment of this disease. When we have not other means at our command, we may employ the pure tincture of iodine, applying it to the surface with a camel's-hair pencil; and with confidence that we shall thus arrest the disease, but perhaps much more slowly than with some other remedies.

Dr. Hachenberg, A. A. Surg. U.S.A., has recently recommended the use of spirits of turpentine. He advises that it should be applied thoroughly every three hours. Dr. H. claims that this remedy possesses a superiority over most of the others in use, on the following grounds: "1st. Its permeability. 2d. It is a ready solvent of the broken-down adipose tissue of the wound. 3d. It has local alterative, stimulating, and sedative effects. 4th. Its anti-zymotic properties. 5th. It is antiseptic and styptic. 6th. It is non-escharotic in its effects. It causes no immediate or chemical eschar, as do bromine, nitric acid, and some other remedies, which are often the means, unhappily, of the retention of vitiated secretion in the wound."

The rules suggested for the application of bromine and potassa are equally applicable to any of the agents which may be employed. The efficacy of the remedy depends, in a great measure, upon the care and completeness with which it is applied.

The following is a statement of cases which occurred at the McDougall General Hospital during the summer of 1863, and illustrate, to some extent, the comparative efficiency of the different agents employed. The solution of bromine referred to was one drachm of the pure bromine to eight ounces of water, and was not the "compound solution" first used by Dr. Goldsmith. Subsequent to the preparation of these tables, having had a personal interview with Dr. Goldsmith, I began using the pure bromine, and with much better effect than I had experienced with the solution.

Whole number of cases treated, 33.

Of these but two were attended with fatal results, and these some days after the gangrene had been arrested. In one case the patient died from exhaustion, the result of extensive suppuration in the knee-joint, the wound having been in perfectly healthy condition for several days. In the other case the patient died from dysentery, his wound having put on a healthy action two weeks before his decease.

In one case, where nitric acid was used, the disease was not arrested, and at the end of ten days it was found necessary to amputate the leg above the knee. The stump healed by the first intention. The average duration of all the cases under all treatments amounts to 12 days.

Number treated with nitric acid, . . .	18.
Average duration of disease, ...	16 days.
Number treated with sol. bromine, . . .	14.
Average duration, ...	6 days.
Number treated with iodine, ...	1.
Average duration, ...	7 days.

The cases were under the care of Drs. Caldwell, Peck, Graves, and myself, respectively, and the sanitary surroundings were as nearly similar as could be possible. We were all agreed upon the constitutional treatment, which consisted in good diet, whiskey, and iron. The figures show strongly in favor of the use of bromine.

General Remarks.—Amputations performed during the progress of hospital gangrene are, as a general rule, disastrous, for the following reasons: The patient is in no condition to rally from the effects of the operation, and the stump is exceedingly liable to be attacked with the disease for the arrest of which the operation was performed. Exceptions to this rule are rare.

The ligation of arteries is sometimes demanded and should always be performed, without reference to the probability of the disease again attacking the artery. Dr. George R. Weeks, Surg. U.S.V., makes the following remarks in this connection:—"I have tied the anterior tibial artery upon the face of a gangrenous stump, and arrested the process by the use of bromine, and the patient recovered as well as by a primary operation. The brachial and dorsalis pedis arteries were tied under the same circumstances, with the same result."—(*Frank Hastings Hamilton, Jr., M.D.*)

CHAPTER V.

WOUNDS.

SECTION 1.—GENERAL CONSIDERATION OF WOUNDS.

Definition.—A wound may be defined as a recent, sudden solution of continuity in the soft parts. This definition excludes contusions, ulcers, fractures, etc.

Division.—For practical purposes, and for the sake of convenience in description, wounds are divided into incised, lacerated, contused, punctured, tooth, arrow, gunshot, poisoned, and occasionally other terms are employed expressive of certain peculiarities of the injury.

An incised wound is one which is made by a sharp, clean-cutting instrument.

A lacerated wound is one which is made by a dull instrument, or in which the parts have been torn asunder.

A contused wound differs from the lacerated only in that the parts have suffered more contusion than laceration, and the term might well be omitted from our nomenclature.

A wound is said to be punctured when a sharp needle-shaped or bayonet-shaped point has entered the tissues. It may partake more or less of the nature of an incised, lacerated, or contused wound.

The term penetrating is employed occasionally to designate such wounds as are made by balls, and other obtuse missiles, and which cannot properly be called punctured. Strictly speaking, however, all wounds, and especially punctured wounds, are penetrating.

A very large proportion of gunshot wounds and all arrow wounds are recognized as penetrating or punctured wounds, but for many reasons both of these two classes of injuries have to be considered under separate and special denominations.

Poisoned wounds, which are chiefly punctured, have also every variety of form, and claim a separation from other wounds only on account of the special nature of the blood-poisoning with which the lesion is accompanied.

In this general consideration of wounds our remarks will have reference chiefly to **simple incised wounds**, which may be considered in the main as typical of all other wounds.

Treatment.—The first indication of treatment in nearly all wounds is to arrest, or to prevent hæmorrhage. This is to be accomplished by the application of cold or ice-water, by hot water, by exposing the surface of the wound to the air, by elevation of the limb, by pressure upon the arteries, or by the removal of such compression as interferes with a free return of the blood through the veins, by ligature, by torsion, by crushing or by acupressure of the arteries, by actual and potential cauteries, by the persulphate of iron and other styptics. These measures will be considered more fully in the chapters on wounds of arteries and of veins.

The second indication is to remove all foreign substances. The necessity of speedily extracting any missile which has penetrated the tissues, and of removing all pieces of cloth or particles of dirt which may have entered, is sufficiently understood; nothing will prevent the surgeon from performing this duty at the earliest practicable moment but their inaccessibility, or the dangers which might attend a farther search. It is not, however, always so well understood that a clot of blood of any considerable size is as essentially a foreign substance, and will almost as effectually prevent union, and determine suppuration, as if a piece of cloth or the fragment of a ball had been permitted to remain.

In order then that no large amount of blood may separate the opposing surfaces of the wound, clots must be carefully washed away with the sponge; but if the blood continues to flow from small vessels, as in all probability it will for a time, only two alternatives remain: the surgeon must wait until the blood has ceased to flow, or he must close up the wound, and at once apply such an amount of pressure as will effectually arrest all further bleeding. The latter method possesses the advantage that it consumes less time; and, if skilfully managed, it is liable to no objections. It need scarcely be said that the attempt to control even small vessels by pressure in such regions as abound in loose areolar tissue, as, for example, in the sides of the neck. in the axilla, at the bend of the arm, in the scrotum, etc., must generally prove unavailing, and that it is only where the underlying structures are close and compact enough to afford a counter-support, that this method can be safely employed.

As to the manner in which this pressure shall be applied, more will be said when we speak of the bandages which are finally to enclose the dressings.

The third indication of treatment is to close the wound. That is to say, simple incised wounds are to be closed immediately, or within a few hours at the latest, when there is any reasonable ground of hope that direct union of the opposing surfaces will occur; but there are a great many cases in which this hope cannot properly be entertained, but in which suppuration, and perhaps sloughing to a greater or less extent, are plainly inevitable. Occlusion of the wound then can serve no useful purpose, and is quite likely to do harm by imprisoning the poisonous fluids and gases.

In order to close wounds and to maintain all their surfaces well in contact, we employ sutures, adhesive plasters, compresses, and bandages.

Of sutures there are several varieties described by surgical writers.

The interrupted suture is the form generally employed, the suture being applied at certain intervals along the margins of the wound. The material most in use is harness-maker's silk, now generally known to the druggists as surgeon's silk—a firm, compact, hard-twisted, white thread; and which, when waxed, combines probably more qualities of excellence than any other material yet suggested. It is strong, flexible, easily introduced, and easily removed; in itself perfectly unirritating, and when thoroughly waxed, scarcely more liable to become a source of irritation by absorbing pus, than a metallic suture. A number of careful experiments, in which silk and wire have been introduced alternately along the same wound, warrant me in making this assertion. Moreover, I have seldom found it advantageous to permit any form of suture to remain after suppuration has taken place, and within that period silk finds in general very little noxious fluid to absorb. If, however, it should be shown conclusively that the metallic suture is not quite so apt to cause ulceration of the tissues as waxed silk, we should still hesitate to concede to it a preference, except in a few special cases, since it is so much less convenient to handle. It can neither be introduced or removed with as much ease as silk, and its cut extremities are often in the way of the dressings. When sutures have to be introduced through deep and narrow canals, that quality in wire which renders it inconvenient for ordinary purposes—namely, its inflexibility as contrasted with thread—renders it much more convenient for this special purpose; and in these cases metallic sutures must continue to be preferred.

Linen thread is but little inferior to silk. It lacks, however, in flexibility, and will not tie into so compact and secure a knot.

Horse-hair, recommended recently by Dr. J. S. Wight, of Brooklyn,[1] is certainly no more likely to become foul by absorption of fluids than wire, but it is liable to the same objection as linen, only in a greater degree. It is too inflexible, and will not make, under all circumstances, a reliable knot.

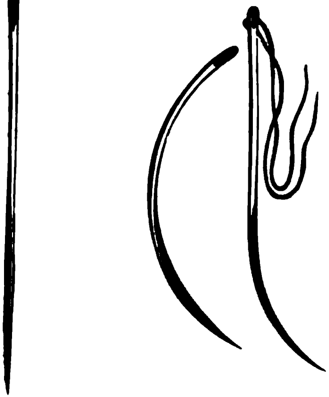
I wish to be understood then as recommending for all ordinary purposes a compact, hard, thoroughly waxed white silk thread, and of the size ordinarily used by harness-makers; only in certain delicate operations will smaller thread be required, and the exceptions will be especially noticed when the operations referred to are under consideration.

Several forms of needles are employed by surgeons, each of which is adapted to certain special purposes.

A perfectly straight needle, with spear-shaped point, and sharp, cutting shoulders, is the most convenient for the majority of large and accessible wounds.

A needle of the same construction, but slightly curved toward its pointed extremity, is required where wounds are less accessible; and curved, or crescent-shaped needles are often useful under similar circumstances.

Fig. 3.



Surgeons' Needles.

Sutures ought seldom to be employed for the purpose of drawing tegumentary or other tissues forcibly together. The strain and labor of support is illy borne by either thread or wire, and they ought never to be put to this test if it can be avoided. They not only prove inadequate in many cases, but their tension causes not unfrequently erysipelatous inflammation, ulceration, and sloughing. In the case of certain wounds, however, and especially in operations upon the vesico-vaginal walls, sutures are the sole reliance, and the risks incident to their use must necessarily be taken.

The most appropriate function of a suture is to secure accurate apposition of the margins of the wound when the tegumentary covering is adequate and falls easily into position, or when it is sufficiently drawn, and supported in place by adhesive plasters and rollers. Thus employed, introduced at short intervals, and not thrust deeper than the skin, they seldom fail to give satisfaction. When employed alone, or whenever they are compelled to bear the principal strain, as in hare-lip, vesico-vaginal operations, etc., they should be introduced remote from the margins.

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[1] Wight.—*New York Medical Record*, vol. 3, p. 434.

When wire is employed as a suture in the closure of ordinary wounds, it is a matter of very little choice whether we use silver, platinum, gold, iron, or lead. For such operations, however, as depend much upon the suture for their results, silver wire, made from virgin silver, rather than from coin silver, is to be preferred, and of sizes varying from No. 27 to 29.

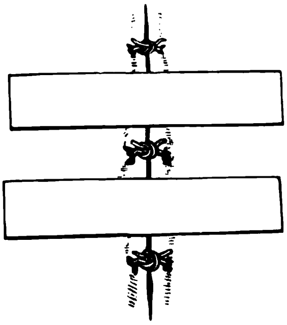
Metallic sutures may be introduced with the common surgical needle; but in certain cases smaller needles, with eyes constructed in such a manner as to prevent the wire from obstructing the passage of the needle, are required.

Other sutures than the interrupted are occasionally employed for special purposes; and although they are seldom useful in the treatment of ordinary wounds, they will be mentioned in this connection.

The continued or glover's suture, known among tailors as the whip, or over-stitch, is reserved almost exclusively for the closure of wounds upon the cadaver.

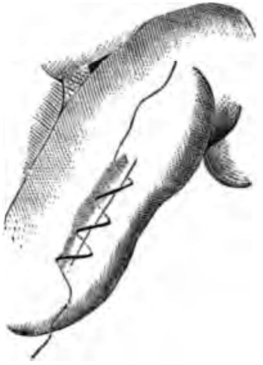
The quilled suture, so called because originally two sections of a quill were employed in its construction, may be made of similar sections of a flexible catheter or solid bougie, or of metallic bars (clamp suture), which are laid parallel to, but quite remote from the margins of the wound, and are secured in place by two or more strong double ligatures. These ligatures, carried by large curved needles, or smaller needles attached to handles, enter where one of the quills is to be laid, penetrate deeply, including the skin and various other tissues, and emerge at corresponding points on the opposite side of the wound. One end of the double ligature is now looped over the quill on one side, and the other free ends are drawn tightly and tied over the quill on the opposite side.

Fig. 4.



Interrupted Suture.

Fig. 5.

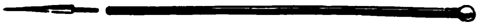


Continued Suture.

Quilled or clamp sutures are occasionally useful in forcing the deeper portions of such wounds as do not admit of pressure from compresses and rollers into apposition; as, for example, in the case of wounds in the ischia-rectal fossæ.

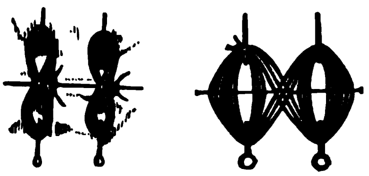
The twisted suture, better known as the hare-lip suture, from its having been used from an early date in operations for hare-lip, is made by transfixing the wound from side to side with a pin or needle, and then approximating the edges by winding a thread under the opposite and exposed ends of the pin. The thread may be carried in the form of the figure 8, or of an ellipse; but in either case it is customary to cross the threads finally from one pin to the other, as represented in figure 8, in order to cover the edges of the wound more completely. Instead of ordinary thread some surgeons prefer the soft thread of candle-wick, loose woollen threads, or india-rubber rings. The hare-lip pin has been made of silver or of gold, with a movable steel point; but an ordinary sewing needle, or a lady's toilet needle with a glass head, will answer very well, provided the point of the needle is removed with a pair of nippers or bone-cutters, after the needle is inserted. The usual practice is to withdraw these needles carefully on the second or third day, leaving the threads, which are in most cases slightly fastened to the surface by dried blood and serum. Many excellent surgeons attach considerable value to these sutures in certain wounds and operations, and especially in hare-lip operations, and we shall find it necessary to explain our objections to them hereafter in that connection; but for the present our readers must be content with the general statement, that we know of no emergencies in surgery in which we would ever prefer them to interrupted sutures.

Fig. 6.



Hare-Lip Pin.

Fig. 7. Fig. 8.



Hare-Lip Suture.

The *serré-finés*, invented in our day by Vidal (de Cassis), are delicate, sharp-toothed clamps, made of silver wire, which maintain their position by virtue of the elasticity of the wire. Being opened, they are made to seize upon and penetrate to a certain depth the opposing tegumentary surfaces, and on being allowed to close, the edges of the wound are approximated. They are awkward and imperfect contrivances, which would not be mentioned except for the name of the justly distinguished inventor.

The edges of the wound having been secured in apposition by a certain number of sutures, strips of adhesive plaster are generally required to relieve the strain upon the sutures, and to close up the intervals. For this purpose the "common adhesive plaster" of the shops, the emplastrum resinæ, or emplastrum lithargyri cum resina, has for a long time been employed. Well-made adhesive plaster improves by age, the plaster becoming gradually incorporated with the linen, and increasing its quality of adhesiveness. Where this quality is important, as in hare-lip operations, the surgeon should therefore select plaster which has become brown by age. If the color is very light and the surface thin and slippery, it cannot be relied upon. If the surface has an oily feel, as happens with old plasters not properly made, the oil may be removed and its adhesiveness partially restored by moistening it lightly with spirits of turpentine. When used, it is to be cut into strips lengthwise, as it will stretch less than when cut crosswise; and then gently warmed by folding its back surface around a vessel containing hot water.

Adhesive plaster spread upon Canton flannel is much stronger than that spread upon linen sheets; but this extra strength is not required in dressing ordinary wounds. The Canton flannel plaster is therefore only employed for making extension in fractures, in diseases of the articulations, and for other similar purposes.

For many purposes the isinglass plaster is preferable to the common adhesive plaster: and it is especially convenient in military practice, since it does not require heat to prepare it for application; but it has not the strength of litharge and resin plaster, and is too easily loosened by moisture to be always reliable.

Dr. J. P. Maynard, of Boston, first suggested the use of collodion in 1847. It is prepared by dissolving gun-cotton in ether, with a small proportion of alcohol, and is then spread with a fine brush upon strips of thin silk gauze, or of sheet lint, and laid quickly over the edges of the wound. The ether evaporates rapidly, and a little delay causes a failure. Some prefer to apply the solution directly to the skin, and then lay upon it the dry strip of cloth. When skilfully done the wound is hermetically sealed; and as the collodion is insoluble in water, it will not be disturbed by moist dressings. The sharp, smarting pain caused by the ether, and the necessity of great haste in the application, constitute the chief objections to its employment.

The India-rubber plaster recently introduced has also many qualities of excellence, and does not require to be heated before it is applied. Indeed it answers its purpose so well that for some time past it has almost entirely taken the place of all the other forms of adhesive plaster.

Finally, the complete dressing of many wounds demands the application of a roller. In some cases it is required as a substitute for the usual clothing, that is, to maintain the natural temperature in the parts. In other cases it serves to retain the adhesive strips more securely in place; but its most important office is to press into apposition the deeper portions of the wound, controlling by its pressure any farther oozing from the smaller vessels, and the consequent interposition of a blood-clot, and thus securing more prompt and certain union of the divided surfaces. To all this may be added what is rather speculative than demonstrable, that the roller probably serves a useful purpose by giving to the loosened tissues, even more or less remote from the immediate seat of injury, that support and solidity which it is easy to conceive is essential to the normal performance of their functions. Thus, for example, when a thigh is amputated the natural tension of the skin, of the muscles, and of other tissues is lost; and experience has sufficiently shown that a moderately tight roller gives great comfort to the patient, if it does not contribute to the health and repair of the stump. It would be singular if it did not do both.

A roller has, therefore, important and varied offices to perform, and skilfully applied it can be of great service; but unskilfully or injudiciously applied it may do great mischief.

When its sole office is to maintain the natural temperature, or support the plasters, as will be the case in certain superficial wounds of the foot or leg, which are unaccustomed to exposure, but in which parts the circulation is apt to be feeble, the roller ought to be applied lightly. When, however, the object is to support the loosened tissues, to compress the smaller arteries, and to force the deeper surfaces of the wound into apposition, it must be applied firmly. If one were to attempt to give the measure of the firmness with which the bandage is to be drawn, we might say with a force equal to that to which these same parts were subjected before the skin and strong fasciæ and the muscles were divided. Within these limits it is quite certain that no harm could be done; but harm is often done by tight bandages; and experience must have taught every surgeon that it is not easy in all cases to determine the exact amount which the tissues can safely bear. If a wound is closed by adhesive strips or by bandages with moderate firmness to-day, they may be found binding immoderately to-morrow, on account of the effusion and swelling which has taken place in the mean time. A very simple expedient will, however, in a large majority of cases, provide effectually against strangulation, at least so far as danger from the bandages is concerned. After closing the wound with sutures and adhesive plasters, and with a piece of sheet lint covered with simple cerate, lay over the whole a large mass of absorbent cotton, and upon this the successive turns of the roller, binding it on very firmly. The elasticity of cotton-batting is such that it will be found very difficult to strangulate the tissues underneath, while it possesses sufficient firmness to cause the necessary compression. By this measure alone almost complete immunity against accidents is insured; but the immunity is made absolute if, at the expiration of twelve or twenty-four hours at most, the scissors are introduced beneath the outer margins of the dressings, and they are carefully divided from each side to opposite the centre of the wound. Some blood is almost certain to have soaked into the dressings; and as the blood has by this time become dried the dressings will usually retain their places even when thus freely cut; and they seldom fail to continue to maintain a considerable degree of pressure and support. If they are disposed to fall off, a single slight turn of a roller will suffice to keep them in position.

In regard to the application of a piece of sheet lint, perforated, and covered with simple cerate, it is mere affectation to say that it is "filthy," since no one knew better than the distinguished author of this sentiment that it need not be filthy; and that, so far as it facilitates the removal of the dressings at a subsequent period, it is always a comfort to the patient, and this is sufficient reason why it, or some convenient substitute, such as vaseline, should be retained.

Mr. Lister, successor of Mr. Syme in the chair of clinical surgery in the University of Edinburgh, recommends carbolic acid as a direct dressing for all wounds.

It is his opinion that suppuration is mainly due to certain germs constantly floating in the atmosphere, and which carbolic acid is able to destroy. Every possible precaution is therefore taken to exclude the air, and to disinfect that which is unavoidably brought into contact with the wound. The interior of the fresh wound being first washed with carbolic acid, of the strength of one part of carbolic acid to twenty of water, the surface of the wound is then covered first with the "protective." The object to be attained in the use of the protective is, to prevent the second or outer dressing, containing carbolic acid, from coming into immediate contact with the wound, since it is considered rather injurious than otherwise to continue permanently the application of the acid. The protective may be made of two or three folds of cloth, or what is better, since it will be impervious to the acid, of a piece of tin-foil. According to Dr. Strachan, who has been a very close observer of Mr. Lister's practice, he has of late made his protective in the following manner. A piece of oiled silk is coated on one side with a thin layer of a mixture composed of one part of dextrine, two of powdered starch, and sixteen of a cold solution of carbolic acid; the latter being of the same strength as the solution employed in washing the wound. This is applied, with the oiled silk in contact with the wound. Over this, as the second dressing, and for the purpose of more effectually destroying the germs which float in the atmosphere adjacent to the wound, the lac plaster is applied, prepared, according to the *British Medical Journal* for November, 1868, in the following manner:—"Take of shellac three parts, crystallized carbolic acid one part. Heat the shellac with about a third of the carbolic acid over a slow fire till the lac is completely melted; then remove from the fire, add the remainder of the acid, and stir briskly till the ingredients are thoroughly mixed. Strain through muslin, and when the liquid has thickened sufficiently by cooling, spread it upon cloth about one-fifth of an inch in thickness."

When it is proposed to employ this as a permanent dressing, the lac plaster thus prepared is laid over the protective, and made to cover a considerable portion of the surrounding integument, to which it adheres firmly; but in cases demanding frequent dressings, the surface of the lac plaster is covered upon its under surface with a solution of gutta-percha in about thirty parts of the bisulphide of carbon, to prevent its sticking.

At Bellevue Hospital, where I have seen this practice adopted in a considerable number of cases, the results have not seemed to me essentially different from those obtained under any other mode of hermetic sealing. Some cases have done remarkably well, while in a few the confinement of the pus and other secretions has been plainly disastrous. I am, therefore, far from being convinced that carbolic acid possesses the extraordinary powers attributed to it by the eminent advocate of this practice. Solutions of the chloride of zinc, 30 or 40 grains to the ounce of water, of the chloride of soda, and a great variety of other antiseptics and stimulating lotions, including dilute alcohol, have occasionally proved useful in my hands, and quite as useful as carbolic acid.

It ought to be mentioned that the method of using carbolic acid as originally described by Mr. Lister, has in his own hands and in the hands of his disciples undergone many changes, so that the method of employing it to-day is by no means uniform. By not a few of the advocates of antisepsis as a means of destroying mischievous germs, other agents have been substituted, and especially of late the bichloride of mercury. Many examples of poisoning from the use of carbolic acid as a local application have been recorded, some of which have come under my own observation, and recently a case has been brought to my knowledge of salivation induced by the topical application of a solution of bichloride of mercury.

The fourth indication of treatment is to control or moderate the reaction, and by this means to anticipate and prevent such accidents as suppuration, pyæmia, gangrene, etc.

This is to be accomplished by rest, by the proper elevation of the limb or of the parts injured, by the timely and careful removal of dressings, including the sutures, by studious attention to cleanliness, by regulation of the temperature, by diet, and sometimes by general medication.

Rest implies not alone that muscular action shall be made to cease; but that the wound shall not be handled roughly, or in any way disturbed so as to cause pain. Moderate elevation is useful as a means of diminishing the supply of blood to the parts. The timely removal of the dressings has reference less to the number of hours which have elapsed than to the condition of the wound. If reaction is violent the dressings may require to be removed as early as the following day; but if moderate, they may be permitted to remain several days. The same rule applies in some measure to the sutures. If the margins of the wound look red or swollen, they ought in most cases to be at once cut and withdrawn carefully. In other cases there will be no objection to their being left five or even seven days.

Cleanliness is best secured by the gentle irrigation of the wound with warm water and clean soap, after the dressings have been removed. We doubt whether there is any better agent for the removal of decomposing animal fluids than warm soap-and-water. It softens and comforts the living structures, it dissolves hardened crusts of pus and blood, and thus makes a way for itself to all parts of the wound; and finally washes away what it cannot render innocuous.

The temperature to which a wound ought to be subjected will depend upon the amount and character of the inflammation which ensues; or upon the condition of the general system as indicating the predisposition. The best mode of regulating the temperature, whenever the inflammation is disposed to be excessive, is through the agency of water. When therefore the feeble condition of the patient, or the lack of vitality in the part which is wounded, seems to indicate that there may be an insufficiency of reaction, the requisite temperature may be obtained through the agency of warm or hot water; but when active inflammation is to be combated, pure water, a little below the temperature of the part inflamed, may be required. For the further consideration of the treatment of the inflammation consequent upon wounds, the reader is referred to the chapter on inflammation.

SECTION 2.—LACERATED AND CONTUSED WOUNDS.

Lacerated and contused wounds differ from incised wounds in several essential points. The hæmorrhage is apt to be less, because the arteries, having been torn asunder by violence, have suffered more injury, and close more absolutely; but if the vessels are large which have been thus closed, it will not be prudent to omit the ligature. The integument at the margins of the wound is generally very thin, and has lost its subjacent vascular connection; or it is of unequal thickness, and serrated; it is crushed and in a measure devitalized; consequently if closed by sutures it is not probable that the edges will unite. Moreover, the adjacent skin has usually suffered contusion or violent stretching, and it is often separated extensively from the tissues underneath; consequently it is liable to speedy death, which liability is greatly increased if it is much compressed by adhesive plasters or bandages. If inflammation ensues, it is more apt to be of a low erysipelatous character. The separation of the skin from the adjacent tissues, also, leaves the skin an opportunity to retract; and in general more force than it is prudent to employ is required to bring the edges again into contact. Finally, the deeper parts, near and remote, have often been severely bruised, stretched, or torn.

The indications of treatment are, therefore, essentially modified. After controlling the hæmorrhage and removing all foreign substances, the surfaces of the wound are to be laid gently together; no sutures or adhesive plasters being employed unless their utility and hazard have been carefully considered. The wound is then to be covered with a piece of lint spread with simple cerate, and this is to be secured in place by a few light turns of the roller. If moderate pressure is required to control the oozing, and especially if it seems important to elevate the temperature, cotton-batting should precede the application of the roller. These wounds demand early and frequent renewal of the dressings.

SECTION 3.—PUNCTURED WOUNDS.

Punctured wounds of the limbs, and of other fleshy portions of the body, such as are made by sharp-pointed instruments, are liable to be followed by the formation of deep-seated abscesses, and especially by tetanus. That pus, whenever in these cases it is formed, should become imprisoned, cannot be a matter of surprise, when it is considered that these wounds are narrow and deep, and that the movable character of the muscles, fasciæ, and integument must insure, in most cases, the formation of successive valvular septa, interrupting the channel of the wound at many points. The greater liability to tetanus after punctured wounds is, therefore, in part due to the imprisonment of effusions, but especially to the fact that nerves and tendons are often penetrated, but not completely divided, leaving them in a state of tension favorable to an increase of irritation and of inflammation.

In punctured wounds, also, arteries are sometimes tapped without being completely severed; in which case none of those circumstances can occur which determine the spontaneous arrest of hæmorrhage. So that these accidents are frequently followed by persistent bleeding, or by traumatic aneurisms.

It may perhaps be inferred from what has been said, that all of this class of wounds demand immediate and free incisions, in order that they may be at once converted into open incised wounds; and we believe some surgeons have declared this to be the only proper mode of treatment. There are two objections, however, to a rule so violent and rigorous. First, the situation and relations of the wound often render free incisions dangerous or even fatal; and second, those most serious accidents of which we have spoken as liable to occur in the case of punctured wounds, namely, abscesses and tetanus, and which one might suppose ought to be very frequent complications, are, in fact, very rare, and not generally to be anticipated. It is only proper, therefore, to convert a punctured wound at once into an incised wound, when the immediate, intense, and persistent pain implies the puncture of a nerve, or the free and persistent bleeding demands the ligation of an artery. In general the treatment is to be conducted by absolute rest, and by the use of such other means as are known to most effectually control inflammation.

The treatment of punctured wounds of the thorax, abdomen, and joints will be considered in connection with the regions in which they respectively occur.

SECTION 4.—TOOTH WOUNDS.

Dr. Gross, in his excellent system of surgery, has very properly, I think, called attention to the grave accidents which frequently ensue upon wounds inflicted by the teeth of animals, and which are supposed not to owe their gravity to any poison which has been conveyed into the tissues.

Repeated examples have come under my observation in which the bite of a finger or of the thumb, inflicted by an enraged person, has caused the most disastrous consequences. In several instances violent inflammation, with necrosis of one or more of the phalanges, has resulted; and in one case it caused death. These wounds have all belonged to the class of either punctured, penetrating, or lacerated wounds; but the gravity of the symptoms has constantly seemed out of proportion to the character of the lesion.

The same thing happens pretty often from the bite of a rat, as I have had occasion to know; and Dr. Gross remarks that the bite of the dog cat, and horse is liable to be followed by similar results.

Dr. Gross does not think that the saliva has anything to do with the bad effects which he has seen ensue; yet he adds, "I would advise strongly, that the part should be well cleansed and bathed with warm salt water, to get rid of any saliva and any other matter that may have been deposited by the teeth." For myself, I confess to a strong conviction that the saliva has much to do with the results which we so often witness in these cases. The saliva of many persons, and especially those salivary and other deposits which gather about the lower teeth, are often exceedingly foul; and there seems little reason to doubt that they may be capable of imparting a poisonous influence to the tissues with which they are brought into contact. The connection between the buccal secretions, salivary and others, and epithelioma of the lower lip, to which further reference will be made hereafter, tends also to confirm this conviction.

These wounds should not only be thoroughly cleansed with warm soap and water, but they should be treated from the beginning by warm water fomentations or soft poultices; while complete rest should be enjoined, and all proper measures should be taken to diminish the general inflammatory diathesis.

SECTION 5.—ARROW WOUNDS.

The weapons formerly employed by our native Indian tribes were the bow and arrow, the scalping-knife, and the hatchet. At present the hatchet is much less used, and the bow and arrow have been in a great measure superseded by the rifle and musket. To a very considerable extent, however, the arrow is still employed in both hunting and in battle. Indeed, in the hands of an expert, at a short range, the arrow is nearly as effective as the bullet. The usual range for the effective use of this weapon is between fifty and one hundred yards. It possesses one marked advantage over the bullet: it strikes its victim silently, and gives no indication where the foe lies in ambush.

The bows employed by the North American Indians are usually from three to four feet in length, and are constructed of some tough, elastic wood, such as willow, ash, or hazel. The arrow is composed of two parts, the shaft and the head. The shaft is made from the dogwood tree, hickory, elm, or reed; sometimes it is composed of two sections, the feathered extremity being made of reed, and about one foot of the other extremity being made of hard wood. Their length varies from two to three feet.

Formerly the material used in the construction of the head was either conchoidal chert, horn-stone, or common quartz; but at the present time most of the tribes use soft hoop-iron. In length they vary from one inch, or even less, to three inches; and in breadth from half to three-quarters of an inch at their base. Some are quite smooth and sharp, and others very rough and serrated on their edges. The stem, or neck, is usually about one inch long.

Fig. 9.

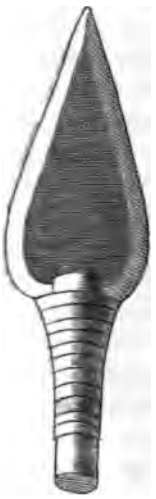
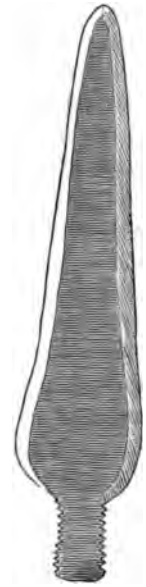


Fig. 10.

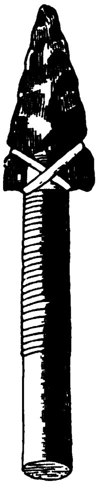


Navahoe Arrow-heads. Actual size.

The wounds made by arrows are usually punctured and more or less lacerated. Occasionally, where the arrow-head is made of iron or steel well sharpened, the wounds partake of the character of incised wounds. They are sometimes projected with great force, and either transfix the body completely or fasten themselves quite firmly in the bone. The wounds made by arrows are liable, therefore, to the same complications which have been mentioned as in some degree peculiar to other punctured wounds, namely, to the formation of suppurating dépôts and to tetanus.

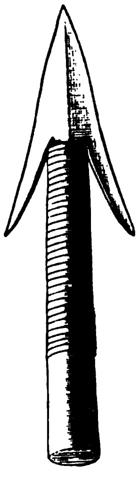
There is, however, in the case of arrow-wounds an additional source of danger and of embarrassment. The arrow-heads in use by all of our native tribes of Indians, whether made of metal or of flint, are expanded at the base, and often distinctly barred; and the neck is made fast to the shaft by being thrust into a slit, and by then binding it in place with cords made of the skin or tendons of animals. When one of these arrows has buried itself beneath the skin, the tendinous thong soon softens and relaxes by the absorption of moisture, and the slightest force applied to the shaft is often sufficient to separate it from the head; but if it is important to remove balls which have lodged in the body, it is still more important to remove these missiles, inasmuch as they are larger, and much more irregular upon their surfaces. In most cases the wound at the point of entrance, and in the fasciæ and muscles through which the arrow-head has passed, has contracted around the shaft so firmly that it is impossible to introduce even the smallest instrument; and the wound must be enlarged by free incisions, from the surface fairly down to the barb before it can be extracted. When a track has thus been made for its exit it may be seized with a strong pair of bullet forceps and extracted; or we may succeed in embracing the expanded portion of the arrow-head with a loop of strong wire passed through a double canula, and by turning the canula slightly the wire will be made to embrace it more firmly, when it may be extracted. The ingenious contrivance of Assistant Surgeon Bill, U.S.A., recommended by him for certain arrow wounds of the chest, and which will hereafter be described, may perhaps here also serve even a better purpose than the double canula. It must be remembered that many of these heads are made of very brittle stones, which would be easily broken under the strong pressure of a pair of forceps.

Fig. 11.



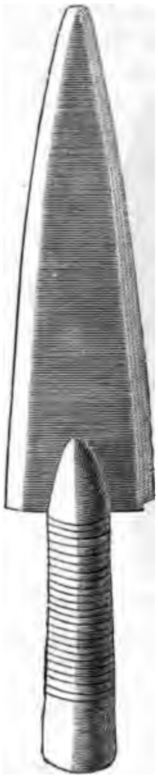
Paioute.

Fig. 12.



Klamath.

Fig. 13.



Sioux.

Actual size. From the author's collection.

When the head is metallic and has penetrated the bone, the point often becomes turned, and the difficulty of its extraction is thus greatly increased. Bill relates that in the case of a man shot in the shaft of the humerus by an arrow, it was only after using both knees as a counter-extending force that he was able to extract the weapon.

Surgeon Clements, U.S.A., reported to the author a case in which an arrow had completely penetrated the ilium, and he was obliged to exert his utmost strength several times, with a pair of dentist's forceps, before he could extract it. In another case the arrow-head had entered the scapula, and at the expiration of three months he cut down to the bone and removed it with a pair of forceps; but not without the employment of considerable force. He then found that it had been doubled or bent upon itself at two points, the extreme point being clinched under the bone.[1] (Fig. 15.) *Specimen* 4,455, *U. S. A. Medical Museum.*

Fig. 14.

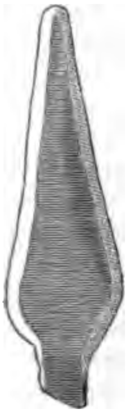
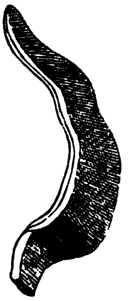


Fig. 15.



Arrow-head in Clements' case.

Whenever it can be ascertained, either from an examination of the superficial wound by the probe or by the finger, in what position the arrow-head has entered the bone, it may sometimes be loosened by carefully rocking the shaft in the direction of the long transverse diameter of the head. If moved in the opposite direction it will bend or break. Indeed, when other means have failed to determine the position of the transverse diameter of the head, the sensation conveyed to the fingers by a slight rocking of the shaft may enable the surgeon to decide this point.

It has been said that the relations of the flat surface of the arrow to its shaft, may be determined by the lateral mark or longitudinal groove upon the shaft, since it has been affirmed to be the practice of Indians to make this groove upon those sides of the shaft which are at right angles with the flat surface of the head. I have in my possession a large number of shafts and arrow-heads from various North American tribes, and I find that many of them are not grooved at all; and that among those that are thus marked there is the greatest variety in the relative position of the mark and the head, and this too even among arrows which belong to the same tribes; and I conclude that the grooves, which are sometimes straight and sometimes winding, are probably either mere matters of fancy, or that they are only private marks. Nor do I find, as other writers have affirmed to be the case, that there is any uniform relation between the slit on the end of the arrow which receives the bow-string, and the disposition of the surfaces of the arrow-heads.

Occasionally a metallic arrow-head impinging upon the side of a bone is driven between the periosteum and bone, and bends as it progresses, so as to make the circuit of a considerable portion of the circumference of the bone. Bill relates two cases of this kind, one of which was upon the ulna and the other upon the fibula; and Kennon relates a similar case in which the iron had become bent around the femur.

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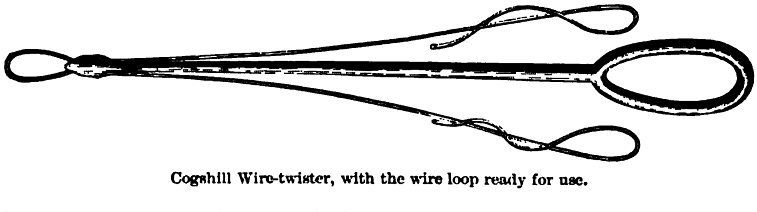
[1] *Treatise on Mil. Surgery.* By the author. p. 530. Baillière Bros.: New York, 1865

When an arrow strikes the calvarium at right angles with the surface, and at short range, it usually penetrates the bone, but not to a great depth; yet sufficiently deep to cause, in some cases, symptoms of compression, which are usually, however, relieved on withdrawing the arrow. If they were not thus relieved it might properly be inferred that a small fragment of the inner plate had been thrust inwards, and that the trephine ought to be employed. In a few cases arrows have been known to penetrate the skull completely. When arrows penetrate the bones of the face they bury themselves to a great depth and often cause very troublesome hæmorrhage.

The intercostal spaces do not generally admit an arrow-head of the ordinary size, unless it enters with its longest diameter more or less parallel to the axes of the ribs; consequently a pretty large proportion of thoracic arrow wounds are superficial. Arrows received upon the thoracic parietes are often deflected, the head being found remote from the point of entrance. In a case reported to the author by Surgeon Jos. K. Smith, U.S.A., the arrow-head, having struck the sternum, was found buried to the depth of half an inch in the head of the humerus.

If the arrow has fairly penetrated the chest, the extraction of its head is a matter of the greatest moment; yet it is seldom that it can be safely accomplished. If the shaft has become detached, very little or no hope of a removal of the head can be entertained; unless it happens to lie near the surface, or the shaft is broken, and that portion which is attached to the head can be felt. So long, however, as the head remains connected with the unbroken shaft success is possible. In such cases Bill suggests that a piece of well-annealed, large-sized iron suture-wire be employed as a loop, to entangle the head and fasten it more securely to the shaft, before attempting the extraction. His mode of using the wire is as follows:—The two ends of the wire are passed through the opposite tubes of a Cogshill wire-twister, or of a long double canula. The loop, having received one twist upon the end of the instrument, and being deflected to a right angle with the shaft, is slipped over the feather-end of the arrow-shaft, and carried down to the head and made to embrace it; when by drawing upon one end of

Fig. 16.



Cogshill Wire-twister, with the wire loop ready for use.

the wire it is made fast to the shaft, and by traction upon the instrument and shaft at the same moment, the head is withdrawn. The success of this method must depend upon the surgeon's ability to enlarge the track of the wound sufficiently to admit the wire and instrument, and upon his address. A failure may properly be anticipated, but in the absence of any better method, it deserves a trial.

Arrow wounds of the abdomen are exceedingly fatal; and the rule which most military surgeons have adopted in relation to gunshot wounds of the abdomen, or wounds made by rifle-balls, namely, that it is improper to search for the missiles, save in rare and exceptional cases, cannot be applied to wounds made by arrows. Arrow-heads must be found and removed if possible; and the lesions of the viscera must be subsequently managed by sutures or otherwise, according to the necessities of the case.

The following *résumé* of the cases reported by Bill will give a very fair idea of the relative fatality of these accidents, in reference to the regions of the body in which they may occur, and in comparison with bullet wounds of the same parts of the body:—

Upper extremities, 28 cases; one death. Lower extremities, 6 cases; one death. Head, superficial, 2 cases; no deaths. Head, penetrating the skull, 3 cases; 2 deaths. Spinal marrow, 1 case; died. Thorax, superficial, 9 cases; no deaths. Thorax, penetrating the lung, 6 cases; 4 died. Thorax, penetrating the heart, 2 cases; both died. Abdomen, intestines not wounded, 6 cases; 3 died; but of these, one died from a gunshot wound. Abdomen, intestines wounded, 15 cases; all died.

It will be observed that the largest numbers of wounds are in the upper extremities; which circumstance Assistant Surgeon Bill ascribes to the fact that the arrow may be seen as it approaches, and the arm is naturally raised to ward off the missile. It is probably in part, also, due to the fact that in Indian warfare it is customary to conceal as much of the body as possible, while in the use of his weapons the soldier necessarily exposes his arms.

The fatality of these wounds in the head and extremities is about equal to the fatality of wounds in the same parts inflicted by round balls; but in the case of penetrating wounds of the chest and abdomen the fatality is greater than in wounds of the same parts by round or rifle balls.

The abstract of the returns of cases of gunshot and arrow wounds, made by six of the medical officers in the Kandyou provinces of Ceylon, during the insurrection of 1817 and 1818, shows that of twenty-two gunshot injuries of the extremities none died; and of twenty-five arrow wounds of the extremities none died.[1] The conical ball was not then in use. This may be accepted, therefore, as in some measure a confirmation of the observations made by our own surgeons.

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[1] *Outlines of Military Surgery*, by Sir George Ballingall. Edinburgh, 1855.

Considering the comparatively harmless nature of arrow wounds of the extremities, and the nearly fatal character of all penetrating wounds of the chest and belly made by these weapons, Assistant Surgeon Bill makes the following sensible remarks and suggestions:—"The Indians have a method of dressing bull's hide for shields for themselves, which renders it arrow-proof. A cuirass made of such material, protecting the whole trunk before and behind, need not weigh more than eight or ten pounds, and by means of it a soldier could enter an Indian fight with a fair chance of escaping death." The Mexicans on entering into a fight with Indians always wrap many folds of a blanket around the abdomen, and thus no doubt secure a certain degree of immunity; but Surgeon Joseph K. Smith in a communication to the author relates the following case:—"A bugler, during an Indian fight, chased an Indian, firing at him with his revolver. When about six feet from the Indian, the latter turned, drew his arrow to the head and shot. The bugler was on horseback, and had his big army overcoat rolled up tightly like a rope, and tied to the front of his saddle. The arrow passed through this mass of cloth, and entered his groin, passing several inches into his body. The soldier, however, recovered with but little trouble."

There is one more suggestion made by Assistant Surgeon Bill, which deserves to be repeated, namely: that in all commands engaged against the Indians, an order should be issued warning the men of the danger of attempting to extract an arrow themselves when the assistance of a surgeon can be obtained.

Poisoned Arrows.

No doubt many savage tribes have practised poisoning their arrows, in order to render the wounds inflicted by them more certainly fatal; but the extent to which this practice has been carried has probably been greatly exaggerated; and among the North American Indians it is almost unknown. Surgeon Edgar, U.S.A., thinks it is confined to the tribes inhabiting the mountainous regions watered by the Pitt River, one of the northern branches of the Sacramento. These people, it is said, grind the dried head of a rattlesnake into an impalpable powder, which is then mixed with the putrid blood and flesh of a dog, and into this the points of their arrows are dipped.

Acting Assistant Surgeon Belden confirms this statement in relation to the Paioutes, a hostile tribe on the Pitt River, Oregon; but he informs me that the method of procuring the poison is to irritate the rattlesnake until he bites himself, and that they then kill and boil it; adding to this various other processes intended to concentrate the poison. Bill admits also that poisoning the arrows used in battles is occasionally practised by the Indians, and relates the manner in which the poison is procured, according to the testimony of a Moquis Indian. The liver of some animal is exposed, and a rattlesnake compelled to insert his fang into it. The animal is then at once killed, the liver removed and wrapped up in the skin and buried. After seven or eight days the bundle is dug up, and the arrow-heads dipped in the putrescent mass; when the points have dried, they are dipped in blood, dried again, and then laid aside for use.

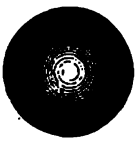
Whether practised much by the Indians or not, it is evident that the arrows seldom convey poison to the wounds which they inflict. Among seventy-six cases of arrow wounds, received from Navahoe, Apache, and Utah Indians, Bill found no case of poisoning in the human subject, and in one instance only had he evidence that an animal was thus poisoned. A horse was shot in the flank with an arrow, and died in the course of the same night with evident symptoms of poisoning; and this is the only case of death from this cause that I have found reported.

Section 6.—Gunshot Wounds.

Under the name of gunshot are included all those wounds which are caused by missiles projected by the elastic power of gunpowder, or other explosive mixtures. These missiles are all more or less obtuse, and they are propelled with great velocity and power. The wounds inflicted by them are, therefore, in most cases, contused, lacerated, and penetrating; and are, in general, subject to the same laws which govern the progress and treatment of all other wounds belonging to these several classes. There are, however, certain points of difference, sufficient to demand for them a separate consideration.

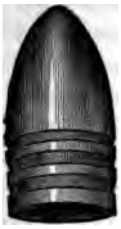
The projectiles employed by civilized nations in modern warfare are small-shot, bullets, round or conical, shrapnel, grape or canister, chain or bar shot, shell, hand-grenades, slugs, solid cannon-balls; and to the injuries inflicted by these missiles we may add: the wounds caused by the powder itself, by fragments of wood or of stone, by portions of the [illegible] the clothing of some other person, etc. By far the largest [illegible] of wounds, however, are caused by the ball or bullet: either [illegible] ball or the cylindro-conoidal; and since the Crimean war the

Fig. 17.



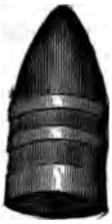
American Round Ball.

Fig. 18.



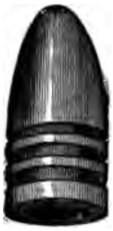
Enfield Conical.

Fig. 19.



Austrian.

Fig. 20.



Springfield.

From Circular No. 6, Surgeon General's Office, U.S.A.

latter, termed usually the conical ball, has almost entirely superseded the former. At the commencement of the late rebellion, both Federals and Confederates were obliged to employ, more or less, the round ball, but these were soon substituted by the conical, and in the latter years of the war both armies were, in general, well supplied with conical balls; the Federals, however, to a greater extent than the Confederates.

The round ball most lately in use by our army weighed 387 grains. The rifles were generally the Enfield, the Austrian, and the Springfield; and the conical balls with which they were loaded weighed respectively 450, 460, and 500 grains.

Other nations employ balls of various sizes and construction, the largest known to the author used in small arms being the Russian, which is said to weigh 940 grains.

A proper estimate of the power and velocity of the conical ball will be obtained from the statement that, when fired from a Springfield rifle, with a charge of sixty grains of powder, it will penetrate, at 200 yards, eleven one-inch pine planks, separated from each other by intervals of one inch and a half; and at the distance of 1,000 yards it penetrates completely one such plank, and enters a second to the depth of one-quarter of an inch.

The round ball, having less momentum, is liable to be deflected either at the point of contact with the surface of the body, or in its passage through the various structures of the body; but the conical ball, with increased weight and velocity, meets with little resistance from any portion of the human frame, at the ordinary range, and is seldom turned aside, but passes straight through, crushing, tearing, and comminuting everything which opposes its progress. The wounds of entrance and of exit correspond in most cases with the traject of the ball before it has entered the body. A few exceptions only are from time to time observed; for example, in the Army Medical Museum at Washington is a conical ball marked 4,622, which entered on one side of the thoracic parietes, and after making the semicircuit of the body, emerged at a corresponding point upon the opposite side.

Such eccentricities occur most often, however, when the force of the ball is nearly expended; and I have happened to see a few examples of this kind, in which a conical ball has been found at a point quite remote from its point of entrance, and wholly out of the line of trajectory.

The wounds made by conical balls are usually irregular in shape at the points of entrance and exit; the entrance being indicated sometimes by a mere slit; or it is irregularly round or oval, or broadly lacerated; occasionally it is round and smooth, as if made by a round ball. The wound of exit is almost always larger and still more irregular in form. The track of the wound is also somewhat conical in form, that is, it gradually widens from the point of entrance to the point of exit.

Wounds made by round balls are pretty uniformly round at the point of entrance, not larger than the diameter of the missile, and usually a little depressed, with somewhat abraded or discolored margins. The point of exit is a little larger than the point of entrance, occasionally slightly irregular in form, and the edges are often perceptibly everted or pushed outwards.

Treatment.—If a ball has passed clean through the body, and other pressing indications, such, for example, as the arrest of hæmorrhage, are not present, the first duty of the surgeon is to inquire whether the ball has been found. If it has lodged near by, or is found caught in the clothing, the force of the ball was nearly spent when it entered the body, and certain important inferences may be drawn regarding the nature of the wound. Arteries lying in the track of the wound are less likely to have suffered destructive contusion; bones, if hit, may not have been broken, or at least they are probably not comminuted. The ball itself is next to be examined, to determine if any portion of it has been left in the track of the wound. Its surfaces are to be carefully observed, to decide from such indentations or facets as may exist, whether it has impinged upon a bone obliquely, or whether it has struck squarely and forcibly, since in the latter case the bone is probably broken into many fragments, and perhaps extensively fissured; so that the condition of the ball itself might almost be sufficient to decide the question of amputation. In one case I have seen a thin scale detached from the surface of a leaden ball, and left in the wound; and balls are not unfrequently split into two fragments of nearly equal size.

The clothing should be carefully examined on the side where the ball has entered, to ascertain whether any portion has been carried into the wound.

If either a fragment of the ball or any portion of the clothing is supposed to remain in the wound, they are to be immediately sought for. Cloth can only be detected with the fingers; and it is most likely to be found near the point of entrance. The fragment of a ball is more often found near the point of exit, since the ball which enters whole can only be divided by contact with bone. Loose fragments of bone are, also, found only on the side nearest the place of exit.

The mode of dressing the wound will vary somewhat, according to the circumstances of the case; the general principles of treatment being the same as for contused and penetrating wounds of any other kind.

As a rule, there is no better application than a fold of sheet lint moistened with cool water, and, if necessary, retained in place by a single turn of a roller. If, however, such support is not required, it will be better to allow the moistened lint to rest lightly upon the surface. This should be changed, or moistened sufficiently often to prevent its becoming dry. On the field, where lint is not always to be obtained, a piece of a flannel shirt, or of a blanket or overcoat, make excellent substitutes. If the dressings cannot for any reason be often moistened, a piece of lint covered with simple cerate is preferable; and if the patient is to be moved any distance, especially if the removal is to be effected in rude conveyances, over rough roads, it contributes greatly to the comfort of the patient to surround the limb, after applying the lint and cerate, with sheets of cotton-batting, enveloping the whole in a roller.

A ball which has entered the fleshy portions of the body and has not passed entirely through, may possibly lie very near its point of entrance, but such examples are exceedingly rare. It is even possible that it may have entered, and have been withdrawn with portions of the clothing which have been driven before it; or it is thought that it may sometimes enter and escape at the same orifice, by rebounding from a superficial bone with which it has come in contact; yet I confess I have never seen such a case.

In a pretty large proportion of cases these missiles, whether the round ball or the conical, will be found immediately under the skin, upon the side of the body or limb opposite the point of entrance, and in the line of its original course. Examples of deviation from this line, as has already been stated, occur much oftener with the round than with the conical ball.

The search for the ball may, therefore, properly be commenced by a careful examination of the body, or of the limb upon the side directly opposite its entrance; and it deserves to be mentioned, that while the ball may be felt and recognized by light touches of the fingers, it is often overlooked if the examination is made rudely; or if it is, under rude manipulation, for a moment felt, it is apt to be immediately lost again by being displaced, and perhaps thrust inwards along the track of the wound.

In the case of a conical ball there is a very uniform disposition of its long axis; indeed among all the conical balls that I have extracted from under the skin, opposite to and remote from the point of entrance, in recent accidents, I do not remember to have ever found one lying with its apex directed towards the skin,—that is to say, with its long axis at right angles with the surface; only that I must except those cases in which a ball has passed through the chest, and it is found presenting between the ribs upon the opposite side.

The position in which the conical ball is so constantly found, suggests an explanation of the great size and lacerated appearance of the wounds made by these missiles, which seems far more rational than that usually given. It has been thought to be due to the rotatory motion of the ball upon its own axis, in consequence of which the tissues have been supposed to be twisted around the ball, as they might be around a gimlet or an auger. The explanation is unsatisfactory; and I prefer to think that the peculiar features of these wounds are due to the tilting of the missile after it has struck the body, in consequence of which it tumbles and plunges through broadside. The fact that the sides of the ball are nearly as often battered and distorted by contact with bone as the apex, affords some confirmation of this opinion; but perhaps the best evidence is found in the fact which I have pretty frequently observed, that a conical ball sometimes causes wounds which cannot be distinguished from those made by round balls; both the wound of entrance and the wound of exit being small and round. In such a case I have supposed the ball passed through without being tilted.

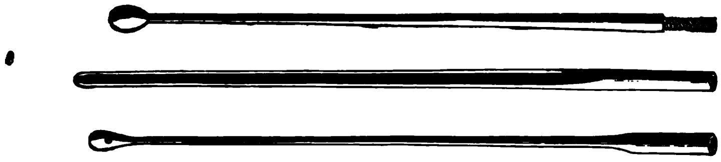
When the ball is discovered, the surgeon should take care to grasp it firmly, if possible, between his fingers and thumb, and make a long and bold incision upon it, permitting the knife to enter fairly into the substance of the ball, so as to divide at once those little firm bands of connective tissue which are drawn deep into all the grooves and depressions of the missile.

In this case, also, the ball should be subjected to careful examination, to determine whether any portion remains; and with the farther purpose of deciding whether the bone has been struck, or to what extent it may be supposed to have been injured.

When the missile cannot be detected upon the side opposite its point of entrance, an examination of the wound must be instituted; first, if practicable, with the finger, as being more intelligent than a probe; and afterwards, if necessary, by the probe. For this purpose a long gunshot probe is generally employed. A large, tolerably firm probe, with a bulbous or olive-shaped extremity, is always to be preferred, as being less likely to go astray from the track of the wound, and as being more sensitive to the resistance offered by a solid metallic body than a light and flexible probe. In case the ball has entered the skull, thorax, or abdomen, the mode of procedure will require special consideration.

If it become necessary to distinguish between a leaden ball and bone, Nélaton's probe, having a smooth porcelain bulb attached, seldom fails to furnish the desired information. This probe I have modified somewhat, by diminishing a little the size of the bulb, so that it may be used in the search for small shot; and by giving to the bulb a pear or egg shape, the small end of which is attached to the shaft of the probe, in order that it may be more easily withdrawn from contracted channels. I have also had the instrument made in sections, united by a male and female screw, in order that they may be separated and placed in a pocket-case. The section attached to the bulb is of steel, and the other section is of silver, formed like an ordinary probe. For the sake

Fig. 21.



Author's Compound Nélaton probe.

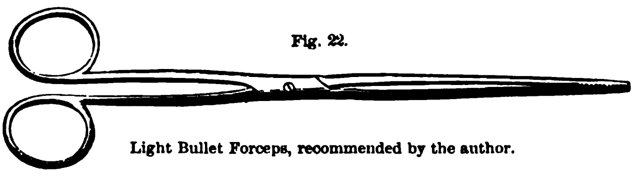
of convenience, I have also a third section constructed as a grooved director, which may be attached at pleasure to the Nelaton probe.

The porcelain bulb being brought into contact with the leaden ball and turned upon itself, receives a delicate impression, which remains after the blood is removed by washing in water, but which is easily effaced by soap and water or by a piece of cloth. This instrument is equally serviceable in detecting a fragment of iron which has become oxidized, by leaving upon the bulb the mark of iron rust.

Dr. V. Gelisch, of Los Angeles, California, has suggested that when a Nelaton's probe cannot be obtained, and it is desired to distinguish between lead and other substances, a probe made of white pine makes an excellent substitute.[1] Mr. De Wilde and others have sought to accomplish the same purpose by the use of an electric probe and forceps, through which a circuit is established when brought into contact with the metal.[2]

A. H. Bell, Ph.D., read a paper before the American Association for the Advancement of Science, at Montreal, August, 1882, in which he described fully certain modifications recently made by him in the "induction balance," for the detection of metallic bodies in the human body. In this paper are described two successful experiments made by Mr. Bell in my office Oct. 7, 1881. In the first case, that of Gen. Calvin C. Pratt wounded at the battle of Gaines Mills, June, 1862, the situation of the ball, previously thought to be in the right antrum, was easily recognized, and the diagnosis was confirmed. In the second case, that of Col. B. F. Clayton, wounded at Cedar Mountain Aug. 9, 1862, the ball, which had never been removed, was supposed by his surgeon to have lodged in the muscles of the back, under the superior angle of the scapula. But the responses of the induction balance clearly indicated to all who were present, including several of our most experienced surgeons, that it was situated in front, a little to the left of the sternum, between the third and fourth ribs, not far from its point of entrance.[3]

Fig. 22.



Light Bullet Forceps, recommended by the author.

The distance within which the presence of metallic substances can be detected by this instrument probably does not exceed two inches; but Mr. Bell entertains a hope that it may be so improved as to increase the range of its usefulness, and even in its present form its utility in certain cases is indisputable.

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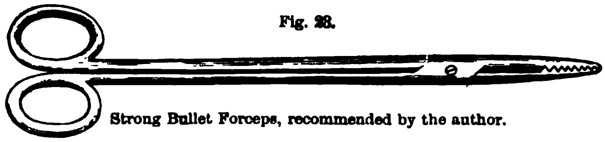
[1] Gelisch. *Pacific Medical and Surgical Journal*, October, 1866.

[2] De Wilde. *Medical Times and Gazette*. 1867.

[3] *Medical Gazette*, Oct. 13, 1881.

For the purpose of extracting the ball a great variety of forceps have been devised by ingenious instrument-makers and by others, most of which are unsuited to the purposes for which they were designed. The truth is, that forceps of any kind are rarely needed in the extraction of balls; and that in most of the cases in which they are needed, a pair of common dressing forceps are sufficient. For exceptional cases, however, there may be required a pair of long, slender forceps, serrated at their extremities, about 7½ inches in length, and which will occupy as little space as possible in the wound. These will serve for the extraction of balls lying deep in the track of a wound, and not tightly impacted in bone or other tissues. For the extraction of balls lodged in bone there may be also occasionally needed forceps of greater size and strength; and for this purpose I have had constructed forceps of the same length as the preceding, with strong blades, straight and serrated also at the extremities, the pivot being placed near the distal extremity of the instrument to increase its power of prehension.

Fig. 23.



Strong Bullet Forceps, recommended by the author.

Buckshot, with all the varieties of small shot, seldom penetrate deeply unless at very short range. They rarely fracture or even penetrate a bone; yet they do occasionally. They are often found, however, completely flattened upon the surface of the bone, lying buried in the periosteum, so that they occasion no sensible elevation of the surface and are not easily detected. Of all the gunshot projectiles they are the most liable to be deflected.

When fired at short range, small shot enter the body as one compact mass, and are almost as fatal as conical balls. Indeed, weapons charged with powder and wad alone, occasion sometimes large and fatal wounds when discharged in close proximity to the body.

Wounds caused by powder alone, of which the most frequent examples are in civil practice, are not, however, often fatal; but they are serious chiefly on account of the discoloration and disfigurement which they occasion. When loose and separate grains of powder have penetrated the skin, some degree of permanent staining of the tissues is inevitable, even though the powder is removed at once; but the longer it remains the wider and deeper will the stain become diffused. The surgeon ought, therefore, to proceed at once, with the aid of some sharp pointed instrument and a magnifying glass, to extract each grain separately. If the powder has been received upon the face, or upon other parts of the body habitually exposed, neither the pain caused by the extraction, nor the great length of time required in its accomplishment, should deter the surgeon from doing this thoroughly.

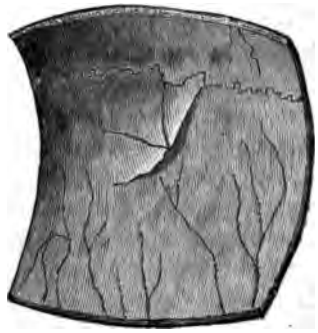
Wounds inflicted by canister and grape do not differ essentially from those inflicted by solid shot or shell, when the several balls of which they are composed remain together; but when separated, the wounds often resemble so closely those made by conical rifle-shot that they can scarcely be distinguished. As a rule, however, canister makes a wound somewhat larger. Large, solid shot, shell, chain, and bar shot make enormous holes, and carry away entire limbs, leaving the muscles, tendons, and other soft tissues hanging in shreds; or, in some cases, smoothly cut, almost as if the separation had been made by an amputating knife. Upon examination, however, it will be found that the surface is contused, insensible, and almost devoid of life; that muscles have been stretched and even torn from their origins, that nerves have been strained and lacerated, that arteries are drawn out upon the surface of the wound and hermetically closed, and that the bone is splintered and comminuted. It will not be surprising, therefore, that most of these patients die from the shock of the injury.

We have ceased to speak of death from the "wind" of a cannon-ball. A sufficient number of examples have been seen in which a cannon-ball has carried away an ear, a nose, the lower jaw, or even both upper and lower jaws together, without having caused any shock or other injury to the body, to render it certain that the wind of a passing shot is harmless. The deaths which have been attributed to this cause were due, probably, to the side glance of a nearly spent missile, which has impinged upon some very vital part of the body. One case of this kind, which came under my observation at Harrison's Landing, in the summer of 1862, I have reported at length in my Treatise on Military Surgery. Death was instantaneous; yet there was no mark upon the body to indicate where the ball had struck.

Gunshot Wounds of the Head.

Superficial gunshot wounds of the head are much more serious in their character than similar wounds caused by other missiles. A leaden ball moving with great velocity, impinging upon the outer wall of the skull in its transit, occasions intense vibration of the solid structure with which it has been brought into contact, resulting often in the immediate death of the periosteum, rupture of the interosseous vascular canals, molecular disturbance of the ultimate bony structures, and more or less grave cerebral disturbance. Consequently it is very common to find after these apparently insignificant injuries, from the mere glance of a ball upon the head, sloughing of the integument and of the periosteum, necrosis of the outer lamina of the bone, followed by a tedious exfoliation or necrosis of both the outer and inner plates. Our Army Medical Museum contains many specimens of gunshot contusion of the cranium, followed by necrosis of one or both plates, or by osteo-myelitis, or meningitis, ending only in suppuration. In a few cases, also, similar superficial wounds are followed by cerebritis and cerebral abscesses. Colonel Farnham died of a cerebral abscess, caused by a shot which had glanced across the top of his head, at the first battle of Bull Run, and which occasioned no wound beyond a simple abrasion of the scalp.

Fig. 24.

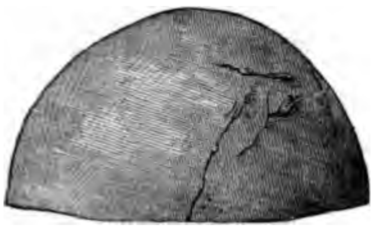


Fracture and depression of inner plate alone. U. S. A. Med. Museum, No. 1,568. From Circular No. 6.

Of 282 cases of incised wounds of the scalp, reported by the Surgeon-General in the Medical and Surgical History of the War of the Rebellion, 263 are said to have recovered.

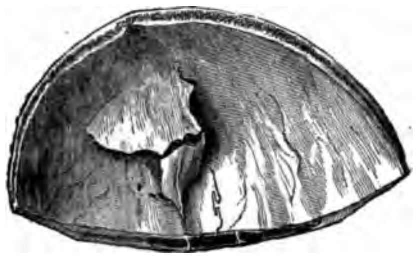
The Army Medical Museum contains, also, several examples of fractures of the inner table alone, caused by bullets; in some of which the inner table has suffered a marked depression. Specimen No. 24, in the same museum, illustrates a similar class of cases, in which the outer table has suffered only a linear fissure, while the inner table is both broken and depressed. There are also several examples in which the outer table has been grooved or furrowed by the missile.

Fig. 25.



Outer Table.

Fig. 26.



Inner Table.

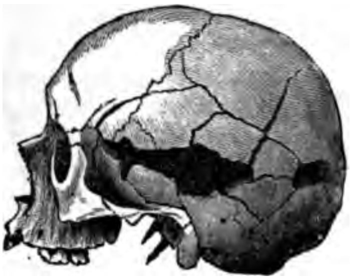
Fissure of the outer table, with depression of the inner. U. S. A. Med. Museum, No. 24. From Circular No. 6.

Perforating Gunshot Injuries of the Head.—Mr. Guthrie, I think, has remarked that in the case of injuries of the upper portions of the brain the fatality diminishes as you proceed from before backwards. The observation may be correct, but I have seen nothing in my experience to confirm it. Injuries of the base of the brain, especially at the posterior part of the base, are certainly very fatal.

A Minié rifle-ball, having passed entirely through the skull, causes wounds or perforations of unequal size, the wound of entrance being somewhat smaller than the wound of exit, and both are, in general, larger than the missile. The same is true with regard to wounds or perforations of the skull made by round balls, but the openings are in general relatively smaller.

The inner plate is generally more comminuted at the point of entrance than the outer; and the reverse is the fact at the point of exit. From both openings there are also usually found extending outwards in one or more directions, fissures of the bone unaccompanied with depression, and which sometimes traverse completely the lines of sutures and involve adjacent bones. Larger missiles almost invariably cause extensive fissures. Minute fragments of bone generally traverse more or less of the entire track of the wound through the cerebral substance.

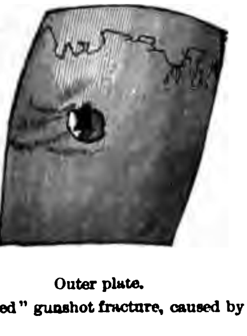
Fig. 27.



Fracture caused by grape-shot. U. S. A. Med. Museum, No. 1,318. From Circular No. 6.

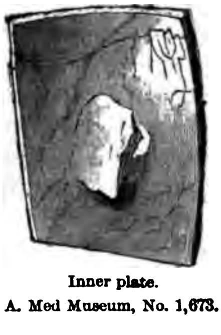
In a few cases, where the missile is projected at a short range, and is consequently moving with great velocity, the opening in the bone at the point of entrance is round, smooth, and unaccompanied with diverging fissures. Such openings have been called "punctured" gunshot fractures; and in most cases the inner plate is found more extensively broken than the outer, and depressed.

Fig. 28.



Outer plate.

Fig. 29.



Inner plate.

"Punctured" gunshot fracture, caused by a pistol-ball. U. S. A. Med Museum, No. 1,673. From Circular No. 6.

The prognosis in these cases is in general fatal; but the example reported by Dr. Harlow, of Vermont, of complete recovery, after a tamping-iron three feet seven inches in length, and one inch and a quarter in diameter, had traversed the left anterior lobe of the cerebrum, will warrant a hope of recovery in almost any case of gunshot injury from a rifle-ball. This accident occurred in 1848, and the man survived thirteen years.[1]

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[1] Harlow. The Author's *Treatise on Military Surgery*, p. 239. *New York Medical Gazette*, July 4, 1868.

The records of the late civil war furnish several examples of perforating wounds of the brain which have resulted in recovery. In Circular No. 6, are reported three cases in which the patients survived gunshot wounds through the anterior portions of the brain; and one of recovery after a ball had traversed a portion of the brain near the vertex.

It is the duty of the surgeon, then, first to examine with the fingers or a probe the wound of entrance, removing carefully any fragments of bone which may be within his reach, and to proceed to treat the case thereafter as if a possibility of recovery remained.

Penetrating Wounds of the Head.—When rifle-balls or smaller leaden projectiles penetrate to the interior of the cranium, but do not pass entirely through, they are generally found resting against or near the inner wall of the cranium upon the side opposite that at which they have entered. They are often, also, deflected from their original course. In a few examples, however, balls have been found near the point of entrance, and extracted. Dr. Hann, of the U. S. Army, found and removed a ball, by the aid of the trephine, which was resting on the dura mater; and Larrey extracted a ball from the superior longitudinal sinus. Quite a number of other similar cases have been mentioned. In a few rare cases, also, the ball has been successfully extracted when lying at a considerable depth.

It is proper then to institute a search, but not to prolong the search far within the cavity of the skull. If the ball is found, and, as is often the case, the opening is not sufficiently large to enable the surgeon to extract it, the trephine must be applied. In all cases the loose fragments of bone lying near the surface must be removed.

As to the prognosis, in case the ball must be permitted to remain, it need scarcely be said that it is necessarily unfavorable. Very few have survived beyond three or four days; but a sufficient number of cases have been reported from time to time in which life has been prolonged for several months and even years, to justify always a faint hope that recovery may take place.

Guthrie relates a case in which the patient survived a year. Hennen, Lawrence, and others have seen examples in which the persons have survived several months. South, in his notes to Chelius's Surgery, has collected several other examples, in one of which, the case reported by Langlet, the patient survived 18 months. Acting Assistant Surgeon Dase, U.S.A., reports a death at eight weeks; and Dr. Bottes, of Seneca county, N. Y., at ten weeks; in both of which the cerebral symptoms only occurred a short time prior to death. I have related in my Treatise on Military Surgery the case of a man having a buckshot in his brain, and whom I found living and in tolerable health at the end of eight months. Additional cases are reported by the Author in the *Medical Record* of September 4, 1875.

The question as to the use of the trephine, in gunshot fractures of the head, is far from being definitely settled; nor, when we consider the variety, and the complicated nature of the conditions which attend these accidents, is it probable that it can be settled absolutely. During the late war in this country the trephine was used a good deal; but precisely to what extent it will never be possible to know, since a great many operations made upon the field were never reported. The statistics in the Surgeon-General's office, made up to the first of October, 1864, furnish 5,046 cases of gunshot injuries of the head, but the compiler of these records acknowledges that they were not yet sufficiently well classified to be made the basis of reliable conclusions. It is stated, however, that of 107 cases in which the trephine was employed, and in which the results have been ascertained, 60 died and 47 recovered; and that of 114 cases where the elevator or forceps alone were employed, 61 died and 53 recovered;—giving to operative procedures a ratio of recovery of 45·3 per cent; while in 483 cases where no operative procedures were adopted, the ratio of recovery was only 20·5 per cent.

These figures, whether they ought to be accepted as testimony or not, accord with our own convictions as to the advantage of surgical interference in a large proportion of gunshot fractures of the skull. While we have often had occasion to regret that the trephine or the elevator had not been used, we have seldom seen accidents or fatal results plainly traceable to their employment.

Gunshot Wounds of the Face.

The bones composing the face are, for the most part, thin or shell-like in their structure, and exceedingly vascular; consequently they are subject to great comminution from the passage of balls; and troublesome hæmorrhages are liable to occur along the tracks of the wounds. According to the report of the Surgeon-General, secondary hæmorrhage was the principal source of fatality in these injuries during the late war. My own experience corresponds with this observation.

The vessels are in most cases inaccessible to the ligature; and when the bleeding does not cease spontaneously, it is proper to have recourse to plugging, and to the persulphate of iron. In case all other means fail, the final resort is to ligation of the carotid; but with only a doubtful prospect of success, on account of the free anastomoses between the arteries belonging to the opposite sides of the neck, and of those belonging to the same side.

The ball ought in all cases to be extracted as speedily as possible, since if permitted to remain it is very liable to give rise to a secondary hæmorrhage, and to exfoliations of bone. I have seen several examples, however, in which the continued presence of balls in these parts has caused very little inconvenience.

Loosened fragments of bone should not as a rule be removed; if replaced, in most cases they unite speedily, and serve in some measure to preserve the harmony of the face. When, however, they are completely detached, or attached only by very slender fasciculi of living tissues, their prompt removal is demanded.

The consideration of gunshot fractures of the lower jaw, and of the various anaplastic operations required to remedy the deformities resulting from gunshot injuries of the face, will be reserved for the sections on fractures of the lower jaw, and regional surgery of the face, respectively.

As illustrating the curious accidents which may occur to the face in gunshot injuries, I will mention the case of a Confederate soldier whom I saw after the battle of Stone's River, in Tennessee. He was kneeling and bending forwards, when he received a rifle-ball upon the crowns of his four lower incisor teeth. The ball and teeth were subsequently found underneath the skin at the top of the sternum. The injury was not followed by any difficulty in breathing or in deglutition, nor by any other serious results beyond the formation of one or two subcutaneous abscesses in the course of the neck.

Gunshot Wounds of the Neck.

Balls sometimes traverse the neck without inflicting serious injury upon any of those vital structures which are here assembled and crowded together as upon a narrow isthmus; but in many cases important nerves or blood-vessels, or even the spinal column itself, have suffered lesion, and death has occurred speedily. Lacerations of the blood-vessels, in which the timely application of a ligature might have saved the life, have generally caused a fatal hæmorrhage before surgical aid could be obtained. In a good many cases, also, the arteries or large veins have not been torn, but only contused by the transit of the ball, and death has taken place from secondary hæmorrhage.

Wounds of the larynx and trachea are not often immediately fatal; but in most cases the injury has been followed by intense inflammatory action, resulting in occlusion of the tube and death. Tracheotomy might no doubt occasionally avert such a termination. I have witnessed one example of complete recovery after the passage of a buckshot through the larynx, and in which no surgical interference became necessary.

Gunshot Injuries of the Spine.

Gunshot injuries of the spine, like fractures of the spine from other causes, are generally fatal, especially where the bodies of the vertebræ are involved. The Surgeon-General, however, reports six recoveries after fractures of the transverse or spinous processes; and one partial recovery where the ball, having fractured the spinous process of the fourth lumbar vertebra, had penetrated to the vertebral canal. The ball and fragments were extracted, and at the end of ten months the report states that he was likely to recover. The two following cases have come under my own notice:—

George A. Uline, Sergt. 125th N.Y.V., was wounded at Gettysburg, July 2, 1863, by a conical ball which traversed the spinous process of the fourth cervical vertebra, and was subsequently removed by incision, with several fragments of the bone and pieces of oil cloth. I saw this man in the hospital nine months after the accident, when he had nearly recovered his original health.

Wm. Madden, enlisted as Wm. McMahon, a private in the 20th Conn. V., was wounded by a rifle ball at Averysborough, N. C., March 16, 1865, which traversed his loins, perforating, or possibly grooving, the anterior surface of the body of the second lumbar vertebra Paralysis of his lower extremities immediately ensued. Some time in September, 1865, a small fragment of bone escaped, in which was embedded a piece of lead. September 19, 1867, I found him suffering only with slight paralysis of his bladder; the wound was closed; a marked posterior curvature of the spine existed opposite the first, second, and third lumbar vertebræ, but this curvature had not increased during several months, and the spine felt firm. I detected the ball lying in the muscles, nearly opposite the point of entrance, and cut it out. It was flattened on one surface and covered at points with calcareous matter. His recovery now seems complete. Sept. 25, 1867, he came before the New York Pathological Society. The members present concurred with me in opinion that the ball had struck the body of the vertebra.

J. J. Woodward, Surgeon U. S. A., wrote to me Nov. 25, 1881: "I may say also that my attention being drawn to the case cited by Hammond from Dr. Hamilton's book, I note that I find in the records of the pension office the report of the examining surgeon, A. L. Lowell, dated May 23, 1866, more than one year before I saw him, from which the following is an extract: 'Ball entered 1¼ inches above iliac crest, passing upwards and backwards apparently injured the twelfth rib, and also the spinous processes of the last dorsal and first lumbar vertebræ. Wound of entrance still open, constituting a sinus from which is still a discharge of pus from disintegrated and exfoliating bone. In the right inguinal region, 1½ inches above the flexure of the thigh upon the pelvis, is also a sinus opening upon the surface by two mouths, this sinus doubtless leading up to the present seat of the unextracted shot. The subject is emaciated, and in a condition of general physical debility.'" Dr. Woodward adds: "Is it not probable that it was the callus about the fractured spinous processes which gave rise to the impression that an antero-posterior curvature existed? The records of the Pension Office show that he died May 29, 1875; cannot learn that an autopsy was made."

I shall make no apology for quoting here, from the seventh American edition of my Treatise on Fractures and Dislocations, a brief account of the case of President Garfield, compiled chiefly from the official report of the autopsy.

President James A. Garfield was shot by the assassin Guiteau, July 2, 1881. The weapon employed being a "bulldog" pistol of large size, which was fired at short range, the ball entering his body on the right side, about three and one-half inches from the spine. Its direction, after penetrating the muscular parietes, could not be determined. Immediately upon receipt of the injury he complained of sharp pains in his right foot and ankle, and later he felt similar pains in the left ankle, with slight pains in the right scrotum. These pains gradually subsided, and after a few days disappeared altogether. Beyond this there was never at any time a symptom pointing to an injury of the spine. No degree of paralysis ever ensued. President Garfield died September 19, 1881, eleven weeks after the receipt of his injury. The autopsy disclosed the following facts:

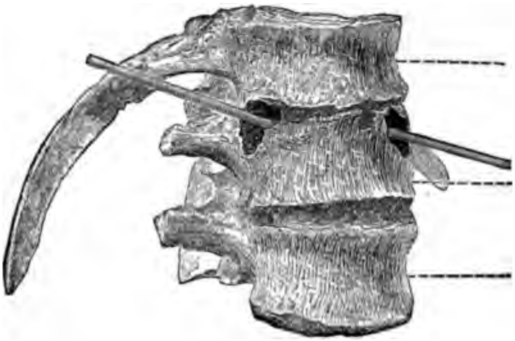
The ball, after penetrating the thoracic wall at the tenth intercostal space, and fracturing the adjacent ribs, passed through the connective tissue and fat behind the upper edge of the right kidney, without wounding the liver, perforated the psoas fascia, and the psoas magnus muscle near its attachment to the first lumbar vertebra, and penetrated the first lumbar vertebra in the upper part of the right side of its body. The aperture by which it entered the vertebra involved the intervertebral cartilage next above, and was situated just below and anterior to the intervertebral foramen, from which its upper margin was about one-quarter of an inch distant. Passing obliquely to the left and forwards through the upper part of the body of the first lumbar vertebra, the bullet emerged by an aperture, the centre of which was about half an inch to the left of the median line, and which also involved the intervertebral cartilage next above. The cancellated tissue of the body of the first lumbar vertebra was very much comminuted and the fragments somewhat displaced. Several deep fissures extended from the track of the bullet into the lower part of the body of the twelfth dorsal vertebra. Others extended through the first lumbar vertebra into the intervertebral cartilage between it and the second lumbar vertebra. Both this cartilage and that next above were partly destroyed by ulceration. A number of minute fragments from the fractured lumbar vertebra had been driven into the adjacent soft parts.

It was further found that the right twelfth rib also was fractured at a point one inch and a quarter to the right of the transverse process of the twelfth dorsal vertebra; this injury had not been recognized during life.

On sawing through the vertebra, a little to the right of the median line, it was found that the spinal canal was not involved by the track of the ball. The spinal cord and other contents of this portion of the spinal canal presented no abnormal appearances. The rest of the spinal cord was not examined.

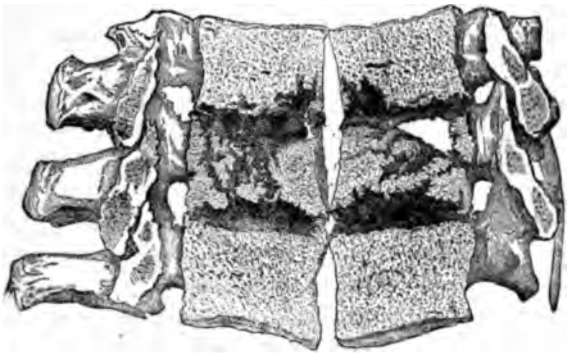
Beyond the first lumbar vertebra the bullet continued to go to the left, passing behind the pancreas to the point where it was found. Here it was enveloped in a firm cyst of connective tissue, which contained besides the ball a minute quantity of inspissated, somewhat cheesy pus, which formed a thin layer over a portion of the surface of the lead.

Fig. 30.



Course of the ball through the first lumbar vertebra, its direction being indicated by the probe.

Fig. 31.



Same specimen sawn open.

There was also a black shred adherent to a part of the cyst-wall, which proved on microscopical examination to be the remains of a blood-clot. For about an inch from this cyst the track of the ball behind the pancreas was completely obliterated by the healing process. Thence, as far backward as the body of the first lumbar vertebra, the track was filled with coagulated blood, which extended on the left into an irregular space rent in the adjoining adipose tissue behind the peritoneum and above the pancreas. The blood had worked its way to the left, bursting finally through the peritoneum behind the spleen into the abdominal cavity. The rending of the tissues by the extravasation of this blood was undoubtedly the cause of the paroxysms of pain which occurred a short time before death.

The fatal hæmorrhage proceeded from a rent nearly four-tenths of an inch long in the main trunk of the splenic artery, two inches and a half to the left of the cœliac axis. This rent must have occurred at least several days before death, since the everted edges in the slit in the vessel were united by firm adhesions to the surrounding connective tissue, thus forming an almost continuous wall bounding the adjoining portion of the blood-clot. Moreover, the peripheral portion of the clot in this vicinity was disposed in pretty firm concentric layers. It was further found that the cyst below the lower margin of the pancreas, in which the bullet was found, was situated three inches and a half to the left of the cœliac axis.[1]

Gunshot Wounds of the Chest.

Superficial Wounds.—Contusions of the thoracic parietes caused by bullets are known occasionally to rupture a blood-vessel and to cause considerable nervous shock; but these results are quite rare and exceptional. It is probable, indeed, that the apparent nervous shock is in most cases due to alarm caused by the belief that the ball has penetrated the body. At the first battle of Bull Run a soldier requested me to examine his back, through which, he said, a ball had penetrated. He was pale and seemed exhausted. Upon examination I found a discolored spot, which he indicated as the seat of the injury, but there was no wound. The ball had struck with such force as to stagger him and to cause immediate faintness. After being assured that it had not penetrated, he returned at once to his command.

Several times I have seen broad eschars, or superficial abrasions of the chest, occasioned by the side glance of large, solid shot, no serious internal injury being produced.

Balls which penetrate only the integument are occasionally deflected and pass some distance over the periphery of the thorax before they escape; the two wounds upon the opposite sides seeming to indicate that the missiles have traversed the cavity of the thorax. Quite often in such cases, although the ribs may not have been broken, some superficial exfoliation occurs. The Surgeon-General reports that the 11,549 cases of flesh-wounds of the thorax found in the returns of the civil war presented a very small ratio of mortality; but that they were long in healing, in consequence, as the writer thinks, of the mobility of the thoracic parietes. The frequency of necrosis in these cases must also, I think, be regarded as one of the principal causes of the delay in cicatrization.

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[1] See official report of the autopsy; made at Elberon, Long Branch, N. J., September 20, 1881, eighteen hours after death, by D. S. Lamb, of the Army Medical Museum, Acting Asst. Surgeon U. S. Army, in the presence of the attending physicians and surgeons—Jos. K. Barnes, Surgeon-General U. S. Army; J. J. Woodward, Surgeon U. S. Army; D. W. Bliss, M.D.; Robert Reyburn, M.D.; and of the consulting surgeons—D. Hayes Agnew, M.D., and Frank H. Hamilton, M.D. The report was signed also by Andrew H. Smith, M.D., who was present as a representative of the coroner of the State of New Jersey.

See, also, the author's summary of the President's case, *Med. Gaz.*, Oct. 1881.

Perforating Wounds of the Chest.—These wounds present the widest range of prognosis, according to the degree and nature of the internal lesions. Wounds of the heart and of the larger blood-vessels are, in general, immediately fatal; yet there are a number of cases on record in which the fatal result has been delayed several months, and even years. Dr. Samuel Purple, of this city, has furnished a *resumé* of twelve cases of gunshot injuries of the heart in which the patients survived from forty-four hours to six years.[1]

I have in my possession the heart of a man named John Kelly, containing a round musket-ball, which lies encysted in the apex of the right ventricle, and which was received twenty years before his death. There is conclusive evidence, however, that during the first five years it lay near the right internal jugular vein, and that having at length made its way through the coats of this vein, it dropped into the ventricle, and finally became imbedded in the walls of the heart at its apex. It remained in the heart, therefore, fifteen years, and was not then the immediate cause of his death.[2]

Perforating wounds of the chest, which do not prove immediately fatal, must still be regarded as dangerous. If, however, a pistol-ball, or a round musket-ball has traversed any portion of the thoracic cavity, and death has not resulted in a few hours from hæmorrhage, and no fragments of bone or other foreign matters have been driven in at the point of entrance of the ball, the chances are very much in favor of recovery. A large proportion of the examples of this class which have come under my notice have recovered completely, and generally after only a few days or weeks of confinement.

The signs which indicate that a ball has traversed some portion of the lungs are, embarrassed respiration, cough, expectoration of blood, the escape of air from the wound, or the presence of air in the cellular structure beneath the integuments. No one of these signs, however, can be regarded as absolutely diagnostic. The expectoration of blood is sometimes caused by concussion alone, and when caused by the passage of a bullet through the lungs, it does not always occur immediately after the receipt of the injury,—frequently not until after the lapse of several hours or even days, and it is rarely seen after the sixth or tenth day. In a few examples blood is not expectorated at any period of the progress of the case. The escape of air has sometimes been caused by a wound which has penetrated only the pleural cavity; in which case air may pass in and out, if the wound is sufficiently patulous, at each inspiration and expiration. When, however, one or more of the above-mentioned symptoms are present, and the direction and depth of the wound favors the supposition, there will seldom be much difficulty in reaching the conclusion that the lungs have been penetrated.

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[1] Purple. *New York Medical Journal*, May, 1855. Also, the Author's *Treatise on Military Surgery and Hygiene*, p. 263.

[2] For a full report of this case see *United States Sanitary Commission Memoirs*, Surgical Series, vol. 1, in a note to Dr. Lidell's paper, p. 163.

In case the ball has struck a rib at the point of entrance, the broken and loosened fragments should be drawn out with the forceps and removed; but little or nothing can be gained by a deep exploration of the track of the wound, since the orifices of perforation of the walls of the thorax, and of the lungs, seldom remain in correspondence after the admission of air to the pleural cavity.

The intercostal artery is often wounded when the missile has impinged upon the lower margin of the rib; but it seldom causes a troublesome bleeding. The records of the civil war, however, furnish eleven fatal cases out of fifteen returned; but it is quite certain that this does not correctly represent the actual number of the accident.

If the artery cannot be seized and ligated in the wound, enlarged by free incision, it has been suggested to exsect a portion of the rib, or to cast a ligature around the rib, including the artery, or to attempt to control the bleeding by pressure made with the fingers.

Whether these wounds shall be closed immediately, or be permitted to remain open for the free discharge of blood and matter, is a question upon which there is at present some difference of opinion. The general practice has been to leave them open in all cases; but Dr. B. Howard, late Assistant Surgeon, U.S.A., has practised closing them in all cases; first removing the contused margins by a clean incision, and then closing the wound by silver sutures, plaster, and compress, so as to secure, if possible, union by first intention. I have seen some of these cases do remarkably well; in others the edges have refused to unite, and the track of the wound has soon reopened. There is nothing in the fact last stated, however, which ought to deter us from attempting to close some of these wounds at once, inasmuch as the refusal on the part of the wound to unite will only place it in the condition in which it would have been if no such attempt had been made.

In my opinion neither plan ought to be adopted as a universal practice; but the wounds may properly, and often advantageously, be closed in the following cases of chest wounds:—First, in all simple incised and punctured wounds of the chest. Second, in all wounds made by round, smooth balls, or by small shot; where the missiles have not impinged upon, or broken any portion of the bony parietes; and in which it can be rendered certain that no foreign substance remains in the track of the wound. Third, when, under any circumstances, both pleural cavities have been opened; since the free admission of air would, in most of these cases, cause speedy death. Fourth, when the pulmonic hæmorrhage is very profuse, and the blood is escaping so rapidly by the external wound as to endanger life. By closing the wound there is a possibility that before a fatal syncope has occurred the blood may coagulate within and that the bleeding may be arrested.

Fifth, when it is ascertained that the impending suffocation is due to the presence of air in the pleural cavity, and not to blood. I have seen a number of cases on the field of battle in which the patients could only breathe comfortably when the finger or a cloth was thrust into the wound; and in all such cases it is proper to close the wound at least temporarily.

The wounds ought not to be closed permanently: First, in the case of gunshot wounds of the chest, made by conical rifle-balls, or by projectiles of a larger size (with the exception as to the presence of pneumothorax, pulmonary hæmorrhage, and the perforation of both pleural cavities already stated). Second, in wounds made by any form or size of projectile, when the projectile has not been removed; or when fragments of bone, pieces of cloth, or other foreign substances are suspected to be within the cavity of the chest.

It will be understood, however, that in no case can there be any objection to such light and movable dressings as may be required for the protection of the external wounds, or as will secure a temporary occlusion of the wound.

After having decided upon the question of closure of the wound, the only point of treatment which remains to be considered relates to the constitutional management of the case. It matters very little whether, in case the wound is left open, we apply wet pledgets of lint or simple cerate, since no applications can have effect beyond the margins of the orifice. American surgeons have not bled their patients in any case which has come to my knowledge, and only in 4 cases reported by Federal and 1 by Confederate surgeons from the experience of the late war, either in cases of hæmorrhage or of apprehended inflammation. I have seen no reason to regret this omission of a practice still recommended by many foreign military surgeons.

Rest in the recumbent posture; small doses of morphine, as, for example, one-sixteenth of a grain every six or eight hours; plain but nutritious diet, and occasionally a little stimulus, have constituted the sole treatment in the vast majority of those cases which have come under my notice.

Hernia of the Lungs, as a result of gunshot injury, is exceedingly rare. It has been said to happen more often when the wound is small, as in the case of a punctured wound, than when it is large. There are two periods at which the hernia may occur; first, immediately on the receipt of the wound, while the glottis is closed, as in the act of coughing, the lung being at the same moment filled with air, and pressed outward toward the thoracic parietes; second, after the wound has closed, when the cicatrix remains thin and yielding, or when the muscular parietes have become atrophied in consequence of injury of any kind, and no longer furnish resistance to the centrifugal pressure of the air enclosed within the lungs.

The latter form might possibly be mistaken for pyothorax; from which, however, it may be easily distinguished by percussion. It requires no treatment beyond the application of a compress and bandage.

That form of hernia of the lung which takes place immediately on the receipt of the injury, and in which the protruded viscus lies exposed, without any tegumentary covering, is the only one demanding special consideration.

Mr. Guthrie speaks of three cases which he saw after the battle of Waterloo; and adds, that he advised them to be let alone, and that his advice having been followed they did very well.

On the field, after the battle of Fair Oaks, my attention was called to a soldier wounded in the left side, a little below the nipple, by a rifle ball. From the wound was protruding a portion of the lungs, about one inch in diameter, but the opening through which it had escaped was much smaller. The mass was completely strangulated, being of a dark purple, or black color, and insensible to the touch. I applied a strong ligature to the base of the hernia, and secured the ligature to the side of the chest by a strip of adhesive plaster. The following morning he was apparently doing well; and I have never heard from him since.

Captain Robert Smith was wounded, at Chancellorsville, in the eighth intercostal space by a round ball, which entered the pleural cavity, but did not wound the lung, passing downward into the cavity of the abdomen. Soon after the lung was discovered protruding, forming a hernia of the size of a small orange, which the surgeons could not reduce, even after enlarging the wound. Subsequently other surgeons made a similar attempt, but failed, and a ligature was applied to the pedicle. On the second or third day this was removed, and a portion of the mass sloughed away. Five days after the receipt of the injury the ball was discharged by stool. The hernia gradually receded, and at the end of three months the patient was reported cured.[1]

Dr. Prince has reported the case of Private Sheridan, wounded at Malvern Hill by a musket-ball which entered between the ninth and tenth ribs and passed out near the zyphoid cartilage. A hernia soon occurred from the anterior wound, and bile escaped from the posterior wound. He was taken prisoner, and no treatment was ever adopted beyond washing the surface of the hernia with water from time to time, which he did himself. He was subsequently exchanged, and eventually recovered completely.[2]

In none of these cases did the patients seem to suffer any special inconvenience from the presence of the hernia.

Experience seems, therefore, to warrant the surgeon in leaving most herniæ of this class to take care of themselves; or in case the hernia is small, and already much strangulated, in applying a ligature to complete its strangulation and separation. Excision is not to be considered, nor is the reduction to be recommended unless the accident is very recent; certainly not after it has been suffering prolonged and severe strangulation.

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[1] Circular No. 6, 1865, p. 24.

[2] *Ibid.* p. 24.

Penetrating Wounds of the Chest.—The permanent lodgment of a conical rifle-ball within the cavity of the thorax generally proves fatal. Round balls cause less disturbance; and pistol-balls, with small shot seldom prove fatal when lodged within the chest, unless from wounds of the heart or large blood-vessels.

In 1876, T. F. Bland, my pupil, carefully collected from the records of Bellevue Hospital all of the cases admitted to that date, in which a pistol ball had entered the cavity of the thorax and remained. Of 21 cases, 5 died; and in only one case did death occur when a large artery or the heart had not been wounded.[1]

Among the remarkable cases of this class recorded is that of Henry Miltenberger, wounded June 9, 1864, by a rifle-ball weighing three-fourths of an ounce. The ball entered at the "lower margin of the seventh rib." He soon returned to duty, and remained in tolerable health until September, 1866, when he contracted a severe cold, which was followed by expectoration of blood, cough, and occasional aphonia. On the 26th of March, 1867, the ball was expelled from his trachea after a violent paroxysm of coughing.[2]

If the ball has penetrated the thoracic parietes and lodged, it will be the first duty of the surgeon to examine the wound, and ascertain whether it may be found near the point of entrance; and in case it is not, a careful examination should be made upon the opposite side, to determine whether it may not be found underneath the integument. In no case can it be justifiable to explore deeply through the substance of the lungs in search of the missile. The subsequent management of the case will be the same as for a perforating wound, only that it will never be proper to close the wound hermetically.

At a later period, when suppuration has taken place, the ball may possibly be found by the aid of a long gunshot probe; and if found lying near the thoracic parietes it may, perhaps, be removed by forceps or by a counter-incision.

Abscesses resulting from the presence of foreign bodies in the cavity of the chest should be kept well open; and after a time they should be occasionally thoroughly syringed out with tepid water or with such disinfectants as carbolic acid, chloride of soda, or bromine.

Gunshot Wounds of the Belly.—In general, it may be observed that gunshot wounds of the belly are much more fatal than similar wounds of the chest; death resulting in a vast majority of cases from extravasation of the contents of the hollow viscera into the peritoneal cavity, inducing fatal peritonitis. Of 414 penetrating gunshot wounds of the belly, reported in Circular No. 6, 308 were fatal, or 74 per cent This probably includes few or none of those cases in which death resulted from hæmorrhage on the field; but even with this exclusion, the rate of mortality is below what can reasonably be expected when the results in a larger number of cases shall have been ascertained.

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[1] *N. Y. Jour. Med.*, February, 1876, p. 124.

[2] Surg. Hist. of the War of the Rebellion, Part I., p. 596.

In some penetrating and perforating wounds of the belly the viscera are not injured; and in such cases the mortality is very small. Their mortality has relation, also, to the character and conditions of the viscera penetrated. Thus, for example, wounds of the liver, stomach, spleen, kidneys, and bladder present the highest rate of mortality, and a wound of the bladder is more dangerous when that viscus is full than when it is empty. Wounds of the small intestines are much more dangerous than wounds of the colon; for the reasons that the small intestines are more movable, they are completely surrounded by the peritoneal sac, and they are so disposed in convolutions, that the missile generally penetrates the canal at three or four different points. A very large proportion of the recoveries after penetrating gunshot wounds of the belly which have come under my notice, were in cases in which the balls had passed through the lumbar or iliac regions, and especially the latter. In many of these iliac wounds, however, it is probable that none of the viscera were wounded. While, on the other hand, wounds in the umbilical region have proven especially fatal.

General Treatment.—It is seldom or never proper to explore these wounds in order to trace out and remove the ball or other foreign substance. Such attempts are almost certain to prove fruitless, and cannot fail to diminish greatly the chances of recovery. It will be remembered that the great danger consists not so much in the lesion as in the extravasation of the contents of the viscera into the peritoneal cavity. In some cases a ball penetrates an intestine or some other viscus, and their contents do not immediately escape. If now the lips of the wound remain undisturbed, adhesion speedily takes place between the opposing peritoneal surfaces, that is to say, between that portion which lines the walls of the belly and that portion which covers the contained viscus, shutting off all communication with the cavity of the peritoneum. To search for a wound in the intestines, also, with the purpose of closing its edges with sutures as recommended by Legouest, is, in my judgment, equally unsound practice. (I shall hereafter, in connection with gunshot wounds of the stomach, refer to a successful case recently reported.) The very attempt to find the wound in the intestine must ensure the admission of air into the cavity of the peritoneum, and the escape of fæcal matter. My own observations and experiments have shown, that in most cases the ball has traversed the intestinal tube at several points; and while one wound is being exposed and closed with sutures, the contents of the intestine must inevitably escape at some of the other wounds.[1]

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[1] Two unsuccessful cases of closure of the ileum by suture. Specimens 4,389, 4,390. Army Medical Museum

The only examples, therefore, in which it can be proper to close an intestinal wound by sutures, are those in which portions of the abdominal wall have been torn away by large shot, and the viscera are fairly exposed. Having in such cases removed the ragged edges of the intestinal wound by the scissors, they must be retained in accurate coaptation by delicate sutures; taking care that the edges of the wound shall be slightly inverted so as to bring only the serous surfaces into contact, between which adhesion occurs even more promptly than between raw surfaces, and very much more promptly than between mucous surfaces. In some few cases, to be determined only by the judgment of the surgeon, it may be proper to stitch the edges of the intestinal wound to the walls of the abdomen, and encourage the formation of an artificial anus.

To these may be added, as proper cases for the employment of the suture, those very rare examples in which the intestine, being wounded, is protruded, constituting a hernia. Under such circumstances, having closed the wound by sutures, the intestine may be carefully returned; but the orifice or lesion in the intestine must be retained, if possible, in a position corresponding to the wound in the abdominal wall.

With these exceptions, the proper treatment of intestinal gunshot wounds, and of nearly all gunshot wounds involving other abdominal viscera, is in the main expectant. The wound should be dressed with a pledget of lint moistened with water, and this should be retained in place with adhesive strips or rollers. The patient should be kept upon his back, or in some position in which he can repose with the most ease, enjoining upon him absolute quiet, so that the viscera may remain in perfect rest. For a period of twenty-four hours, no fluids or solids should be received into the stomach, since either may cause that peristaltic action which must increase the danger of extravasation. Enemata are equally objectionable. Solid opium, in doses varying from one-half to three-quarters of a grain, should be administered at intervals of from four to six hours, the opium being conveyed into the stomach by a tablespoonful of water. Solid opium is to be preferred to morphine, for the reason that it is less likely to occasion nausea. It is true, however, that the extent to which it is to be employed in any case must be determined by the amount of pain, but usually the quantity of opium above recommended will subdue the pain, and arrest all peristaltic movements. Sedatives of any kind administered to the production of stupor, paralysis of the bladder, and such complete paralysis of the muscular coats of the intestinal tube as results in tympanitis, are, according to my experience, injurious. I cannot agree, therefore, with those gentlemen who prefer in these cases to "narcotize" their patients. After a large experience, my conclusions upon this point are positive. I have seen many cases of gunshot wounds of the belly, under moderate doses of opium, conducted to a favorable issue, and very few indeed which have terminated favorably under large doses of either opium or morphine.

After the lapse of twenty-four or thirty-six hours, drinks, food, and stimulants may be given as the condition of the patient may require; but cathartics and enemata are not admissible for several days.

In several instances balls lodged in the cavity of the belly have eventually passed by the rectum. I have recorded four, drawn from the experience of the late war, in my Treatise on Military Surgery, in all of which recovery took place. Mr. Longmore and Mr. Guthrie have each reported one example, and several cases are recorded in the U. S. Surgeon-General's report.

Fæcal Fistulæ.—Fæcal fistulæ result in a pretty large proportion of cases in recovery. I have reported in my Treatise on Military Surgery thirteen cases, most of which came under my own observation; and in all of these examples a spontaneous cure took place within a few weeks or months at the longest. In the history of these cases it has generally been noticed that the openings have closed once or twice, and opened again, before the final closure has taken place. (See "Fæcal Fistula." Chapter on Injuries of the Abdomen.)

Some of our surgeons have employed opiates, under an impression that such measures favored the closure of these fistulæ; but according to my observations no therapeutical measures have proved serviceable, except a strict adherence to a fluid diet, such as milk, animal broths, etc. Solid particles of food are apt to lodge in the fistulæ, and cause them to reopen when partially or completely closed. A fluid diet avoids this source of delay in the process of cure.

Gunshot Wounds of the Stomach.—That a ball has entered this viscus may be inferred from the situation of the external wounds; the præcordial pain; the prostration; hiccough and vomiting; but no positive evidence can be afforded except from the vomiting of blood, and the escape of the contents of the stomach through the wound.

The recorded examples of recovery after this accident are very few. The case of Alexis San Martin, in whose person Dr. Beaumont, of the U.S.A., made his famous experiments upon the gastric juice, is well known to the medical profession.[1] Dr. Peters, of the U.S.A., has also reported the case of a soldier wounded September 13, 1862, by a pistol-ball. For two months the stomach discharged its contents through the wound; but it finally closed without surgical interference, and his recovery was complete.[1] Dr. Otis, in his Surgical History of the War, leaves us in doubt whether it is this case of Dr. Peters (case 185) or case 187, which, out of the 19 reported cases of recovery, alone can be accepted as authentic. In many of the cases, there was no evidence that the stomach had been wounded.

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[1] *American Medical Times*, April 4, 1863.

Dr. J. W. Brooks, of Chicago, has reported the case of a man in whom both the stomach and left kidney were penetrated by a ball from a Derringer pistol, the patient vomiting blood and passing blood through the urethra. There was no surgical interference with the wound or the ball, which was found lying under the skin of the back. The treatment consisted in the moderate use of opiates, the external application of hot water fomentations, almost total abstinence from food or drinks for several days, and absolute rest in the recumbent posture. His recovery was speedy and complete.[1]

Dr. John H. Hinton, Surgeon to the Presbyterian Hospital, New York, has also reported the case of a young man who was shot through the stomach, Feb. 12, 1884, with a pistol ball, conical, 32 caliber. The ball was removed from under the skin by Dr. Hinton, and under a judicious, but almost purely expectant, plan of treatment his recovery was rapid and complete. Dr. Hinton has appended to his report of this interesting case an account of some experiments made by him, which seem to indicate that extravasation of the contents of the stomach does not necessarily follow its penetration by balls.[2]

Gunshot Wounds of the Liver.—In most of these cases the patients die quickly from hemorrhage. A large proportion of the remainder die from inflammation and from the formation of abscesses. Nevertheless the number of recoveries reported is not inconsiderable. Guthrie alone mentions eight recoveries.

The Surgeon-General U. S. A. reports that 173 cases of gunshot wounds of the liver are returned as having come under treatment in our civil war, and of these 32 recovered. It must not be forgotten, however, that in the cases of most of those who died from hæmorrhage alone, the character of the injury was probably not recognized, and they do not appear in the Surgeon-General's report.

I have reported elsewhere one case of recovery after a pistol wound of the liver; and I have recently had under my charge a gentleman from California, who was shot through the liver and right lower lobe of the lungs by a pistol-ball. An enormous abscess was subsequently formed in the track of the wound, which was opened by Dr. J. C. Shorb, of San Francisco, the abscess discharging pus and bile, and which had not completely closed nine months after the accident, although his health was nearly restored.

If a ball has entered the liver and lodged, it may be proper to search for it carefully with a probe, provided the orifices in the walls of the abdomen and liver remain in correspondence. The wounds ought to be left open to allow of the free discharge of blood, or bile and pus; the therapeutical treatment being directed mainly to the prevention or reduction of inflammation.

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[1] Brooks, *Chicago Med. Jour.*, September, 1872.

[2] Hinton, *Trans. N. Y. State Med. Assoc.* for 1884, p. 482.

Gunshot Wounds of the Spleen and Pancreas.—I am not aware that any cases have been reported of recovery after gunshot injuries of either of these organs, except the case of Behan, who died four years after the receipt of a gunshot wound at Sebastopol, a fragment of a bullet being found in the spleen after death.[1]

Gunshot Wounds of the Kidneys.—The Surgeon-General's records contain reports of 26 recoveries after gunshot wounds of the kidneys. While a certain number of these cases were satisfactorily verified, others were not. Hæmaturia, and the escape of urine through the track of the wound, constitute the most reliable diagnostic signs.

Legouest reports a case of complete cicatriza ion of a gunshot wound of the kidney, verified by an autopsy; death being caused by a wound of the knee received at the same time as the wound of the kidney.

The treatment in such a case must consist mainly in relieving the bladder often, so as to prevent the accumulation of bloody clots, and in keeping the wound well open on the back to permit the free escape of the urine.

Gunshot Wounds of the Bladder.—The danger of these wounds depends somewhat upon whether the bladder is full or empty at the time of the receipt of the injury; but especially upon the relations of the wound to the peritoneal sac. Lesions occurring at any point of the bladder covered by peritoneum are almost certainly fatal. Indeed, it has not yet been conclusively shown that in any such case the patient has recovered. It is certain, however, that recovery has taken place in several cases; but it is probable that in all these examples, the bladder contained sufficient urine to lift the reflection of the peritoneum above the track of the wound.

I have recently had under my charge Sergeant Post, of the 61st N. Y. Vols., who was wounded at Spottsylvania, May 12, 1864, by a rifle-ball, which entered just above the pubes, two and a half inches to the left of the median line, striking the top of the pubes, and emerging behind and beneath the right nates, two and a half inches lower than the point of entrance. It is his impression that he had not emptied his bladder for some hours before he was wounded. On the following morning urine began to escape from the anterior wound, and subsequently it was discharged also from the posterior wound. Still later a piece of his India-rubber overcoat and a fragment of the pubic bone were removed from the anterior wound. Four years after the receipt of the injury his health was completely restored, urine had long since ceased to pass by either orifice, but the posterior wound remained open.

The case of Private Brownell, under my charge at Central Park U. S. Hospital, wounded at Gettysburg by three buckshot which penetrated the bladder above the pubes, has already been published. His recovery was complete.[1]

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[1] *Surg. Hist. of War of the Rebellion.*

Dr. Livingston, of this city, reported to the New York Pathological Society, January 25, 1866, a case in which he had removed successfully a calculus enclosing fragments of bone, from the bladder of a man wounded in the battles of the Wilderness, in 1864, the ball having entered "near the right external ring."[2]

My friend General Potter was also shot through the bladder, at Petersburg, in 1865, by a rifle-ball which entered above the pubes; from which injury he has made a complete recovery.

In addition to these cases drawn from the experience of the late war, it is pertinent to add the case of a citizen, Mr. Jones, shot during the New York riots of July, 1863, and reported by Dr. Van Buren. The ball, weighing one ounce, penetrated the bladder above the pubes, while the bladder was distended with urine.[3] I have seen Mr. Jones often since the injury, and he has recovered completely and without impairment of the functions of the bladder.

It is worthy of special notice that in each of these four examples the treatment was almost wholly expectant; and in neither of them was a catheter retained in the bladder, for the purpose of ensuring a free escape of the urine by the urethra. In each instance the fistulous openings closed spontaneously, and without much delay.

The conclusion to which we might justly arrive, in view of the experience above narrated, is, that the practice heretofore recommended and adopted by most army surgeons, of introducing a catheter into the bladder through the urethra and permitting it to remain for several days, is at least unnecessary. Indeed, a farther and more extended observation in a class of cases having many points in common with gunshot injuries of the bladder, namely in those cases in which perineal urethrotomy has been performed, confirms this conclusion. There are many surgeons at the present moment who consider the retention of a catheter in the bladder after this latter operation as not only useless, but as absolutely injurious.

The most dependent orifice made by the bullet should be opened freely, and every opportunity given for the escape of the urine in this direction; and the catheter may be with propriety occasionally introduced through the urethra to ensure the thorough evacuation of the bladder, but even this ought to be practised with caution and not too frequently. Rest and the moderate use of opiates constitute the remaining important remedial measures.

Ballingall, in his treatise on Military Surgery, has collected nineteen cases in which balls having entered the bladder have subsequently been removed by some of the cutting operations usually made for stone: the first operation of this kind having been made by Frère Jacques in 1698 Since the close of our late war a number of similar cases have been reported by our own surgeons, among which I can recall Dr. Livingston's case, already referred to, a case in which Dr. Dougherty, of Newark, N. J., was the operator, and a remarkable case in which a fragment of a hand grenade, encrusted with earthy phosphates, was removed by Surgeon Randolph, U. S. A. In the Surgical History of the War will be found a careful description of most of these cases, accompanied with a numerical statement in tabular form of twenty-one cases of lithotomy for the extraction of projectiles or traumatic vesical calculi.

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[1] *Treatise on Military Surgery*, by the Author, p. 871.

[2] Livingston. *New York Medical Record*, vol. 1, p. 183.

[3] Van Buren. *New York Medical Journal*, May, 1865.

Balls which enter the pubic cavity through its bony parietes are usually followed by troublesome, and often fatal abscesses, caused by the numerous small fragments of bone which are generally detached and which it is seldom possible to remove. Whenever it is practicable, the detached fragments should be removed; and as soon as pus has formed, great pains must be taken to ensure its prompt and thorough evacuation.

Gunshot Wounds of the Extremities.—Gunshot wounds of the extremities, in so far as they are merely flesh wounds, have already been sufficiently considered in our general remarks: in their relations to injuries of the bones, arteries, etc., they can be more appropriately studied in connection with fractures, amputations, resections, and the ligation of arteries.

Gunshot and other Injuries of Nerves.

Concussion of a nerve is usually caused by the fall of a heavy missile upon some portion of the body considerably remote from the nerve trunk to which the special influence of the shock is conveyed. It is followed by a temporary suspension of nerve influence in the parts supplied by the nerve, and in most cases ends in a speedy and complete restoration of function.

Contusion ensues upon a similar injury inflicted upon the integument directly over the nerve, compressing it, perhaps, between the bone and integument; or it may be caused by the passage of a ball through the tissues in the immediate vicinity of the nerve, but without actual contact.

The lesions and subsequent phenomena resulting from contusions do not differ materially from those caused by laceration or partial section of a nerve, and will not, therefore, demand a separate consideration.

Lacerations, partial section, or contusions of nerves may affect motion, sensation, and nutrition in those parts to which the injured nerve is distributed; and these changes of condition may exist in very unequal proportions. Motion is more often impaired than sensation, and indeed sensation is often exalted while the power of voluntary motion is almost completely lost.

The following is a brief summary of the results observed in these cases. Pain, with diminished or increased tactile sensation: in most cases the tactile sensations are diminished. Voluntary motor power either entirely lost or present only in a much less degree than natural; while galvano-electric contractility is seldom or never wholly lost. The paralyzed muscles waste or become atrophied, and often in a degree which implies defective nutrition beyond what mere disuse would occasion. At first this atrophy is accompanied by a loss of tone in the muscles, in consequence of which they have a soft and flabby feel; at length, however, there ensues an increased tension, perhaps a contraction and shortening, causing more or less distortions of the limbs. In some cases the wasting is moderate, while the contraction and tension are excessive. In rare examples the contraction exists without any degree of wasting.

Paralysis of the opposing muscles may also cause deformities, where no abnormal muscular shortening or contraction exists.

The nutrition of the skin and its appendages is affected in some cases in a remarkable manner, especially in those examples in which the pain is of a burning character. These changes usually commence while the wound is healing, and at the same time, perhaps, that the muscular and areolar tissues are becoming atrophied, and the limbs contorted; the palms of the hands, the fingers, and other portions involved in the neural disturbance, assume a glossy appearance resembling chilblains; or the skin may be mottled, red, and pale in patches; the folds in the skin disappear and it sometimes cracks as if opened by the extreme tension; the hair falls off and the nails become incurvated in both their long and lateral axes. Perspiration over the affected parts is generally lessened, sometimes it ceases altogether: in other cases it is excessive; or it may be altered in quality, presenting a strong acid reaction and odor, or the odor may be highly offensive.

Accompanying these changes, or even in cases attended with fewer complications, the joints often become swollen and tender, presenting a condition closely resembling articular rheumatism, which condition concurs with the muscular contractions in causing anchylosis.

Eczema in some of its many forms is also a very frequent sequence of nerve injuries, where the nerve trunks have not suffered a complete separation. It is especially apt to appear in connection with the glossy skin.

Either in consequence of the extension of neuritis, or for some other reason not easily understood, the functional disturbance often extends to nerve trunks not originally injured. In other cases various neural phenomena, such as pain, muscular contractions, etc., manifest themselves in structures not supplied from branches of the nerve originally injured, nor from contiguous trunks, and which admit of no explanation except through reflex action.

Finally, the cicatrices of wounds often become the sources of neu ralgic pains, in consequence probably of the implication of some branch or filament of a nerve in the dense cicatricial tissue.

Complete Section.—The symptoms which ensue upon complete section of a nerve are more uniform, but occasion usually much less suffering.

There is at first complete insensibility and total loss of muscular power; even electro-magnetic contractility disappears. The limbs soon become œdematous, the skin appears thick and dry; the cuticle, which is of a brown or yellowish tint, remains only in patches here and there. The nails become incurvated, but to a less degree than in cases of partial separation or other injuries of the nerves.[1]

Treatment.—Pain is, of all the symptoms accompanying partial lesions of nerves, that which is at the same time the most afflicting and the most difficult to overcome. In a large proportion of cases the cure is only accomplished after a long period of time, and under a system of management directed more to the preservation or improvement of the general health, than to the direct or immediate abolition of the pain. Morphia, administered by the stomach, or by the epidermic or hypodermic methods, may be required to assuage the extreme suffering, but as to its influence in accomplishing a final cure, or in diminishing the frequency and severity of the successive paroxysms, I am compelled to say that it very much oftener does harm than good. The same may be said of all other narcotics and stimulants; whose ability to do mischief is only less than that of morphia, in proportion as they have less ability to temporarily allay pain.

Destruction of the nerve in the cicatrix by caustics or the knife, section of the nerve trunk, or section with removal of a considerable portion of the nerve, very seldom fail to give temporary relief, but in most cases, after the lapse of a time longer or shorter, and generally as soon as the wound is fairly closed, the pain returns with unabated severity. The few exceptional cases, however, in which these procedures have brought about a final cure will warrant a resort to the one or the other in certain otherwise incurable and desperate cases.

Electricity has also in some cases wrought most unexpected and almost marvellous results; but its effects are capricious and uncertain, and in many examples it only aggravates the sufferings. A succession of blisters, applied even to the parts directly suffering from hyperæsthesia, are sometimes useful. Dr. Mitchell has applied them with evident benefit to the palms of the hands when suffering with the peculiar burning pain above described. Leeches have also, in his experience, now and then given relief, when applied over the course of the inflamed nerves. It is, however, worthy of especial notice that in most of all of the cases which came under his observation when the burning pain was present, the greatest temporary relief was afforded by moisture, so that these unhappy patients were accustomed to carry constantly a bottle of water and a sponge to keep the parts moist.

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[1] *Gunshot Wounds and Other Injuries of the Nerves.* By S. Weir Mitchell, M.D., George R. Morehouse, M.D., and William W. Keen, M.D., Acting Assistant Surgeons, U.S.A., in charge of U.S.A. Hospital for Diseases of the Nervous System. Philadelphia 1864.

Gentle frictions made upon the cicatrix have, in a few cases, given relief.

The muscular hyperæsthesia, manifested in all attempts to move the limb, is most certainly overcome by passive motion, which must be persisted in, despite the complaints of the patient. The same is true in a great measure of the articular pains. It has even happened, sometimes, that the acute lancinating pains of large nervous trunks have been speedily improved or wholly dissipated when the anchylosis has been overcome; in some of which examples it is more than probable that relief has been afforded by the removal of pressure from certain nerves, possibly also by the complete rupture of other small and suffering branches.

Muscular contraction is best restored by galvano-electricity, by frictions, and by passive motion. Electricity, especially, is often capable of awakening contraction in muscles which have long ceased to respond to the action of the will. Rapid alternations of heat and cold, by means of the hot and cold douche, will sometimes prove useful. Active exercise should be substituted for or added to passive motions as soon as the patient finds his muscles subject to the control of his will. If anchylosis of the limbs cannot be overcome without the aid of anæsthetics, there should be no hesitation in resorting to them as often and as fully as may be necessary. In a few cases it may finally be required to divide tendons, or other fibrous or muscular bands which offer insuperable obstacles to motion.

In case a nerve has been completely divided, union and restoration of the neural functions may occur at an early or a very late period, and the surgeon should not fail to make the electro-magnetic test at short intervals for a period of many months, in order that he may avail himself of the earliest opportunity which the reunion will furnish, of a renewal of the vital, muscular contractility.

CHAPTER VI.

WOUNDS INFLICTED BY STINGING VENOMOUS INSECTS.

Syn.—Vulnera Veneno Infecta, Insectis Aculeatis, (R. C.)

THE poison conveyed by the stings of **bees** and **wasps** is seldom sufficient to cause anything more than a local irritation; but even this when the wound is inflicted upon certain parts of the body, as, for example, the back of the mouth, may occasion death. If the stings are numerous also, severe constitutional effects may result.

A careful examination should be made, with the aid of a lens, to ascertain whether the stings remain, and if found they should be at once removed.

Cool lotions or cold poultices will in general afford relief to the pain; but the most permanently efficacious remedies are stimulating lotions, such as the diluted liquor ammoniæ, cologne water, camphor liniment, alcohol, whiskey, brandy, very hot water, etc., which cause a temporary increase of the pain, but in most cases soon dissipate it altogether.

The stings of the **mosquito**, **gnat**, **midge**, **bug**, and **flea**, are less poisonous, but when inflicted at many points they sometimes cause severe constitutional disturbance.

The same local treatment is appropriate as recommended in the case of the stings of bees and wasps.

Some of the larger varieties of the **centipedes**, especially those found in hot climates, are probably slightly venomous; but the centipedes of Northern America and of Europe are harmless.

Spiders (Arachnidæ).—The bites of most spiders are innocuous, but it has been generally asserted that the bite of the species known as the **tarantula** is exceedingly venomous, causing much swelling, and sometimes intense constitutional disturbance. A note to the American edition of Druitt's Surgery, for 1860, informs us that this opinion is incorrect, and that the bite is followed by no particular bad effect; at least, that no such effects have been observed in Central America, where the insect abounds. Dr. Paolo Panceri, of Naples, has also recently made some experiments concerning the poison of this spider. Having procured two of the tarantulas of Pouille, of a variety especially noted for producing the phenomena of tarantulism upon persons bitten, he caused in succession a land turtle to be bitten in the lower eyelid, an aquatic salamander upon the back, a pigeon upon the breast, two verdels in the breast; then he inoculated the venom of the tarantula upon a third, a fourth he caused to eat one of the secretory glands, and, finally, he caused a rabbit to be bitten on the upper lip. Wishing to continue his experiments higher in the animal scale, Professor Francesco Gassi volunteered to allow his left hand to be bitten.

These experiments, continued between June 15th and July 15th, established the fact that the bites of the famous tarantula exhibited no difference on these occasions from the bites of other spiders, except with reference to the pain and swelling, which were much greater from the bite of the tarantula than from the bite of other spiders.

Dr. Panceri concludes that the opinions entertained by the celebrated Roman physician Baglioi, and by others, that the poison of this insect causes *tarantism*, or involuntary motions of the limbs like dancing, is an error due in part to popular credulity and in part to some ill-observed cases of hysteria.

The only insect whose poison can be considered as truly virulent is the **scorpion**, which also belongs to the class of arachnidæ, or spiders. In Africa and Asia the body of the scorpion attains sometimes the length of six or ten inches, and the malignity of its venom seems proportioned to its size. In Europe and North America the animal is much smaller, and is generally regarded as innocuous. The poison is contained in a couple of sacs, situated at the base of the claws which terminate the body posteriorly.

The wound made by the scorpion should be treated by the ligature, by free incisions or excisions, and poultices containing carbolic acid and sweet oil. The internal remedies are ammonia, brandy, and opium.

CHAPTER VII.

WOUNDS INFLICTED BY VENOMOUS SERPENTS.

Syn.—Vulnera Veneno Infecta, Serpentibus, (R. C.)

All of that sub-order of reptiles, recognized among zoologists as **viperina**, are more or less venomous. This group includes not only the species known as the viper, but also the **crotolus** or **rattlesnake**.

The viperina are, in general, characterized by the following distinctive features. The body is comparatively thick; its movements are sluggish; the tail is short; the head is broad and flattened; the upper lip hangs on either side like the lip of a mastiff, and the jaws open very wide.

Of the rattlesnake, Professor Holbrook has described six species, all of which are venomous, the poison of the **massasauga** being the most virulent. The poison glands are situated below and behind the orbit; from which ducts convey the secretion to sacs placed beneath the roots of the fangs. The fangs, of which there are two, are attached to the upper jaw, and contain canals which communicate with the sacs. When not in action the fangs are folded inwards upon the roof of the mouth; from which position they are suddenly erected when the animal is preparing to strike. The poisonous secretion is slightly yellowish, thin and semi-transparent, and its quantity does not usually exceed three or four drops. During the cold seasons of the year when the snake is torpid, the secretion is thick and diminished in quantity, and possesses very little virulence; but in hot weather and during the procreating season, its quantity and virulence are increased. Dr. Weir Mitchell, of Philadelphia, has in one case seen fifteen drops ejected, when the fang had not been used for several weeks. The same gentleman observes that its toxic qualities are not essentially impaired by boiling or freezing, or by treatment with alcohol, iodine, the chlorides, acids, or alkalies. When simply dried it retains its virulence for an indefinite period.

Fig. 32.

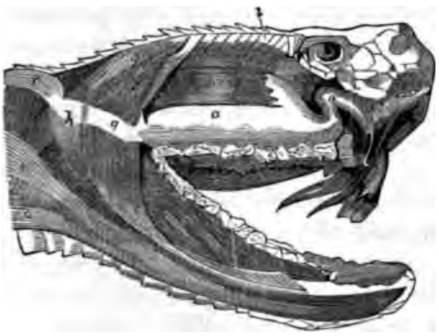
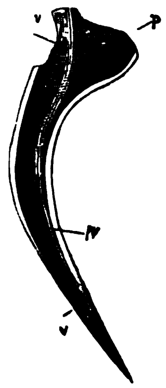


Fig. 33.



Head and Fang of the Rattlesnake.

Fig. 30. Head of the rattlesnake. *a*, *a*. Poison gland, and its excretory duct; the latter cut open at its extremity. *e*. Anterior temporal muscle. *f*. Posterior temporal muscle. *g*. Digastricus. *h*. External pterygoid. *i*. Middle temporal. *q*. Articulo-maxillary ligament, which joins the aponeurotic capsule of the poison gland. *r*. The cervical angular muscle. *t*. Vertebro-mandibular muscle. *u*. Costo-mandibular muscle.

Fig. 31. Poison fang, magnified. *p*, *p*. The pulp cavity of the tooth. *v*, *v*. The canal along which the venom flows, truly on the outside of the tooth.

The **water moccasin**, or **cotton mouth**, abounds in the southern portions of the United States, but is not found north of the Pedee river in North Carolina. It has no rattles, but, like the rattlesnake, it is supplied with fangs and a highly venomous poison.

The **copperhead** belongs to the same genus, **trigonocephalus**, with the moccasin, but is not reputed so venomous.

Professor Holbrook describes also a reptile of a beautiful red color, surrounded by black rings, margined with yellow, and about twenty inches in length, found chiefly in the potato fields of the Southern States. This is the only species of the genus **elaps** known in this country. The upper jaw is furnished with permanently erect fangs and a sac containing poison, but probably of a much less virulent character than the poison of the reptiles before described.

The **hooded snake** or **cobra di capello** belonging to the genus **naja**, found in the East Indies, is scarcely less venomous than the **crotilus**, but the symptoms in general develop more slowly, and there is usually less local inflammation and swelling. In some cases, however, death has occurred very speedily after the reception of the poison.

The **viper**, or **adder**, is the only venomous reptile in Great Britain, and is found also in greater numbers in many parts of Europe. The **spotted adder**, so common in many of the Northern States of America, is not the same reptile, the latter being wholly innocuous.

In the case of nearly all of their poisons, experiment has shown that they are harmless when received into the mouth or stomach, or when applied to the tegumentary surface of the body. Even when applied to abraded surfaces their peculiar poisonous effects have not usually been observed.

Symptoms.—So far as I have been able to learn, a large proportion of the persons struck by venomous serpents in this country recover. Dr. J. T. Scott, of Iowa, who has seen many cases of wounds inflicted by rattlesnakes, informs me that in no instance which has come under his notice has the patient died. The intensity or gravity of the symptoms, moreover, is exceedingly varied; the results of the inoculation being apparently dependent upon many conditions, such as the age of the patient, the amount of poison received, the degree of virulence, or activity of the poison. It is more fatal when received directly into a vein than when received into the cellular tissue only, and wounds of the head and trunk are more fatal than wounds of the extremities. Children are more liable to succumb to its influence than adults. Where several are bitten at the same time those who are last bitten are the least exposed to a fatal poisoning.

In a certain proportion of cases no constitutional symptoms are manifested. The parts in the vicinity of the wound, however, seldom fail to become quickly swollen; which swelling spreads rapidly until, in the case of the arm, it often involves the whole extremity and a portion of the side of the body. The inflammation does not differ essentially in appearance from diffuse cellulitis, or cellulitis of an erysipelatous character, except that the limb is more apt to assume a mottled appearance from congestion or extravasation of blood in the tissues, and that the swelling is sometimes accompanied with unusual coldness and local anæsthesia.

The constitutional symptoms, when present, appear to be due first, to a direct impression upon the nervous system. There is not only in such cases local anæsthesia, but also general prostration, tremors, and intermittent pulse, dilated pupils, delirium, and coma. When this class of symptoms predominate, death occurs speedily, sometimes within forty or sixty minutes, as in the case lately reported by Dr. Shapleigh.[1] Dr. Wainwright, of this city, died within six hours after he was bitten by a rattlesnake. Second, the constitutional symptoms appear sometimes to depend less upon the direct impression upon the nervous system, and more upon the general influence of the poison upon the blood, the symptoms presented being of a typhoid type, and death occurring in a few days. Finally, the constitutional symptoms may be due almost exclusively to the local inflammation, suppuration, and gangrene; and if death takes place, the event is likely to be postponed two or three weeks, or longer. In some cases which have been related to me, belonging to the first class, and in which recovery has taken place, a permanent disability of the nervous system has ensued, indicated by muscular weakness, morbid apprehensions, and partial loss of the intellectual powers.

Treatment.—In all countries a multitude of specifics have obtained more or less reputation for the cure of persons poisoned by the venom of serpents; but most of them are of such a nature as to leave a conviction that the reported cures were only due to the safe and speedy elimination of the poison by the unaided efforts of nature. It seems quite probable indeed that up to the present moment no actual specifics have been discovered; and that it is the duty of the surgeon to treat all of these cases upon certain well-established general principles.

The local treatment is, first, the adoption of speedy measures to remove the poison from the tissues in which it has been deposited, by suction with the mouth, or by cupping glasses. Second, excise or destroy with the actual cautery the parts wounded, or even in some cases amputate at once the wounded member. A case has been related to me in which a lad was bitten by a rattlesnake on his finger, and without delay he chopped the finger off. No symptoms of poisoning ensued. Third, apply a ligature tightly above the wound, in case the wound is received upon either of the extremities; Dr. Mitchell having observed that any delay in the admission of the virus into the circulation has the effect of rendering it less noxious.[2] Fourth, apply to the wound and to whatever parts are inflamed or swollen, sweet oil and flaxseed poultices, or tincture of iodine; and if suppuration or gangrene ensue, make free incisions and cover the whole with yeast, carbolic acid, or charcoal poultices.

As internal remedies stimulants, such as ammonia, brandy, whiskey, etc., should be employed to an extent sufficient to sustain the system in its struggle against the deadly poison, and to aid in its elimination; but it is absurd to follow the teachings of those who advise absolute intoxication. There is no evidence that stimulants, when used to this extent, have ever served any useful purpose. Opium should be given only when the special indications for its employment are present, such as excessive pain, restlessness, wild delirium, etc.

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[1] Shapleigh. *American Journal Medical Science*, April, 1869.

[2] Researches upon the Venom of the Rattlesnake. Smithsonian contribution, Jan. 6 1871, by S. Weir Mitchell, M.D.

Among the recent remedies suggested for snake poisons, it seems necessary to mention the tincture of iodine, employed internally through the stomach and by subcutaneous injection and externally, as recommended by the late Dr. Brainard, of Chicago. Dr. Mitchell found that dilute iodine injected subcutaneously controlled in some measure the local symptoms, but that it had no influence, however employed, in diminishing the constitutional symptoms, or in preventing death. Simple astringents injected subcutaneously were found equally efficacious, so far as the local phenomena were concerned. "Bibron's antidote," equally extolled by some, is composed as follows:—"℞. Potassæ iodidi, gr. iv.; Hydrargyri chloridi corrosivi, gr. ij.; Brominii, f. ʒ v.—Misce." Of which ten drops are to be given in wine or brandy every thirty or sixty minutes. Mitchell declares that, according to his experiments, this so-called "antidote" possesses no such properties.

Dr. Halford, of Melbourne, claims to have met with extraordinary success by injecting ammonia into the veins, and Dr. Shortt, of Madras, has obtained similar results from injections of the liquor potassæ; but Dr. Fayrer, of Calcutta, author of *Thanatopia of India*, who has had occasion to treat many cases of snake-bites in the Indies, says that in his experience both of these remedies have proved equally powerless.

Among the older remedies the Tanjore pill, containing a large proportion of arsenic, once enjoyed a great reputation in certain quarters, as has also Fowler's solution of arsenic; but they have long since been discarded as possessing no specific influence, and as on the whole more likely to do harm than good.

Circular No. 3, 1871, from the office of the Surgeon-General U. S. A., contains reports of seven examples of snake-bites, only one of which proved fatal. The report concludes with a quotation from Dr. Fayrer to the effect that the mortality from snake-bites in Bengal and the adjacent provinces, during the year 1869, was not less than 11,416; and that in his opinion the annual mortality from this cause, in British India, is not less than 20,000. Dr. Otis adds, "I question whether so many deaths have occurred on this continent, from such cause, within the historical period."

CHAPTER VIII.

HYDROPHOBIA.

Syn.—Rabies: Lyssa, (R. C.)

Origin.—Hydrophobia never originates in the human species, nor is there any evidence that it is ever conveyed from one human being to another. In certain inferior animals, however, it originates spontaneously, and from these sources it is conveyed by contagion to other animals and to man. It occurs most frequently in animals of the canine and feline species, especially in the dog, the wolf, the fox, the jackal, badger, and the cat. It may be conveyed by inoculation to horses, asses, hogs, sheep, rabbits, birds, and probably to most animals. The average period of incubation in dogs is about 40 days, the minimum being two weeks, and the maximum between three and four months.

The spontaneous origin of hydrophobia has been attributed to the season, to the influence of heat and of cold, to sudden changes in temperature, to excessive thirst, to rage, to unwholesome food, confinement, want of the couch-grass, and to unsatisfied sexual appetite; but most of the later writers affirm that investigations carefully made do not fully sustain either of these opinions. The disease is unknown in many portions of the world; but wherever it is known to exist, it originates at all seasons of the year alike, and, it is said, without any special reference to either of the other conditions named. According to Eckel, however, it occurs much more frequently in the male than in the female, and more often in mongrels than in those of pure blood, and is especially less frequent in such as have been castrated. It is probable that under different circumstances different causes operate in its production; and that occasionally other conditions, not yet observed, may determine the result.

Symptoms in the Dog.—In the dog there is in most cases no dread of water, but on the contrary the animal usually seeks every opportunity to quench his thirst. At first he is sullen, restless, impatient; at times foaming, but always capricious; the gait becomes unsteady and staggering; his voice or bark is changed, and he early evinces signs of delirium by barking and springing at imaginary objects; his tongue is swollen; his saliva is scanty and viscid; and as the disease approaches its termination his legs become paralyzed, his lower jaw falls, and the eyes become sunken and dull. During the whole progress of the malady which generally lasts from five to eight days, the paroxysms of rage and violence occasionally remit, and are succeeded by intervals of quietude, in which, however, the slightest provocation will induce him to bite, and may even arouse him to phrensy.

Symptoms in Man.—The average period of incubation in man varies from five weeks to three months; in some cases it has been extended to one or two years. Occasionally examples have been reported in which the disease has not manifested itself until after the lapse of ten or fifteen years, and one case is reported as having occurred after nearly twenty years,[1] but these accounts have never been accepted as reliable. On the other hand, cases are reported of its accession as early as the seventh and eighth day.

In a large proportion of cases the earliest symptom of hydrophobia in man is a return of morbid sensibility in the cicatrix, which soon becomes inflamed and swollen, and may perhaps ulcerate; the pain, sometimes accompanied with numbness, often extending along the limb in the track of the principal nerves. In exceptional cases the cicatrix inflames after the accession of the general symptoms; and still more rarely, there is no return of pain or of inflammation in the original seat of the wound, during the whole course of the malady.

Succeeding to or concurring with the local manifestations are general febrile symptoms, possessing no peculiar diagnostic features, unless it be that they are accompanied with unusual mental depression, and peevishness. Speedily, however, the malady advances to the second stage, characterized by well-marked and distinctive signs. The mouth becomes filled with a viscid, tenacious mucus; the muscles of the neck and jaw feel stiff and rigid; deglutition is accomplished with difficulty; respiration is spasmodic and irregular, sometimes catching, as when one suddenly plunges into water, or sighing; sharp pains are experienced in the chest and præcordia; there is excessive thirst, with perhaps nausea and vomiting, the matter ejected from the stomach being, after a time, green and viscid; the angles of the mouth retract; the brows corrugate; the eyes glare; at intervals the whole body is thrown into convulsions, which are sometimes tetanic and sometimes epileptiform. During the progress of these symptoms the mind is generally in a state of constant apprehension, alarm, or absolute despair. The body is also in a condition of remarkable hyperæsthesia, such that the slightest noise, a breath of air, or even the touch of a feather is sufficient to excite a paroxysm.

The dread of water is a symptom rarely absent when the disease is well developed. This symptom, from which the name hydrophobia has been derived, is due solely to the fact that every attempt to swallow water, or any other fluid, causes a spasm of the muscles of deglutition, and at the same moment a spasm of the muscles of respiration, which seems to threaten instant suffocation. Even the rima glottidis closes firmly, allowing of neither expiration or inspiration; and the struggles of the sufferer for air are sometimes prolonged until the face is livid and the eyes seem to protrude from their sockets; or until, as sometimes fortunately happens, death suddenly brings relief.

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[1] *New York Medical Journal*, December, 1869.

The effort to swallow solids is also, in general, attended by the same phenomena; but fluids cannot be grasped by the pharyngeal muscles, and their deglutition demands more effort and causes more violent and continued spasms.

Where death does not occur during one of these paroxysms of suffocation, it finally takes place immediately after the cessation of some unusually prolonged paroxysm, apparently from mere exhaustion. Occasionally death is preceded by a complete subsidence of all the characteristic phenomena of hydrophobia; the patient eats and drinks with composure, and, to one unacquainted with the malady, his condition might inspire a hope of recovery; but this apparent remission only announces the accession of the third, or paralytic stage, which soon closes with incoherency, delirium, and fatal collapse.

In most cases death takes place as early as the third day. It has been delayed two or three weeks, and in one case death occurred within sixteen hours. In 72 cases collected by the late Dr. Blatchford, of Troy, N. Y., the average period of fatal termination was three days.

Differential Diagnosis.—Tetanus, hysteria, certain inflammatory affections of the throat, and certain cerebral affections, are sometimes attended with a difficulty or dread of swallowing liquids, and with spasms of the muscles of deglutition and of respiration, but these symptoms never assume such prominence as in the case of the malady under consideration. It is not, however, so much the presence or absence of any single phenomenon that determines the diagnosis, as the complete history and concurrence of symptoms. Nowhere else, it can safely be affirmed, is the same or even a similar group of morbid phenomena presented.

Pathology.—Nothing has yet been determined as to the seat and nature of this disease, and it seems unnecessary to refer to those opinions which at the best can be regarded as only speculations.

The direct cause is known to be the saliva, or the secretions accompanying the saliva of a rabid animal; and for the successful inoculation of the poison it must be applied to a wound, or to some raw or abraded surface. All that are bitten do not develop the malady. Hunter states that of twenty persons bitten by the same dog only one contracted the disease. Other similar facts have been recorded; but most writers declare that probably not more than one in four escape.

This immunity obtained by so large a proportion of persons bitten, is ascribed chiefly to the fact that the saliva is wiped from the tooth by the clothing, or by the outer surface of the integument, before the tooth enters the flesh.

Treatment.—The long period of latency after the reception of the poison may not, perhaps, imply that it remains during all this time imprisoned by the tissues in which it has been deposited, and that no portion has made its way into the circulating fluids, but it will justify a hope that such is the fact; and the first duty of the surgeon, at whatever period he may be called before the accession of the disease, will be to remove thoroughly all of the suspected parts. In short, he must adopt the same preventive measures that have already been recommended in cases of snake wounds, and which apply equally to all other poisoned wounds. If caustics are to be used, it is not probable that one agent possesses any more value than another, except as it may be more prompt and energetic than another; but it is proper to mention that Mr. Youatt says he "has applied lunar caustic to upwards of 400 persons, and four times on himself, after bites from dogs decidedly rabid, and he has not seen the disease appear in one instance." The statement has an air of looseness and of exaggeration which compels me to question its accuracy.

As to the curative treatment, or the treatment of the disease after its complete announcement, experience has furnished very few if any lessons worthy of being mentioned. Nearly all of the systematic writers declare the malady incurable, notwithstanding that a multitude of empirical remedies have from time to time been proclaimed as infallible. Even the few cases of cure reported by intelligent physicians have, it is affirmed, turned out to be errors in diagnosis, or a misstatement of facts, wherever they have been subjected to a searching criticism. I have neither the time nor opportunity to revise these statements and conclusions, but it is my belief that some cases of genuine hydrophobia have terminated in recovery, either spontaneously, or by the aid of judicious medication.

Not one of the so-called specifics merits a trial; nor does it seem worth while any longer to burden the literature of surgery with their record. If cures of hydrophobia have been wrought, it has not been accomplished by remedies of this class, but by a careful adherence to those general laws which govern the treatment of most other maladies. Admitting, therefore, that we are not yet able to neutralize or render innocuous the poison, there can be no difficulty, in the case of a disease whose symptons are so pronounced, in ascertaining the most prominent indications of treatment, and giving aid to nature while contending with the enemy.

Nearly all the phenomena presented in the history of these cases point to irritation, or disturbance of the nervous system, as their immediate source, and especially to irritation of the medulla oblongata, and of the pneumo-gastric nerves; and whatever remedies allay without exhausting nervous sensibility, or are reputed to control spasmodic action and assuage pain, may be properly administered. The patient should be kept in a quiet and moderately darkened apartment; as far as possible his mind should be composed by words of encouragement and hope

Morphine should be administered by the aid of enemata, or by subcutaneous injection, but not in overwhelming doses, and finally the system should be sustained and nourished by such stimulants and nutrients as the patient can be persuaded to take. Where suffocation is imminent from spasm of the glottis, the surgeon might hope sometimes to prolong life by opening the larynx. Of Pasteur's recent experiments and observations in relation to the prevention and cure of hydrophobia by inoculation I hesitate to speak until more satisfactory evidence as to its value has been presented.

CHAPTER IX.

GLANDERS.

Syn.—Equinia, (R. C.)

Glanders, so far as is known, originates spontaneously only in the horse, ass, or mule, but it may be communicated to other animals, and to man.

Symptoms in the Horse.—There are two forms of the malady described by veterinary surgeons.

In one, called **farcy**, or **button farcy**, the lymphatic system is primarily affected, the lymphatic vessels and glands becoming indurated and enlarged; which condition finally terminates in a tardy and unhealthy suppuration. Sooner or later, however, unless the disease is arrested, the mucous membrane of the nose is affected, and all the usual symptoms of glanders are presented.

In the second form, the malady attacks primarily the nostrils, and this variety is distinguished especially by the name **glanders**. It is characterized by an early enlargement of the submaxillary glands; by an abundant and continuous discharge from the nostrils; at first the discharge is thin and serous, then more thick and glairy, and finally purulent, or sanious and exceedingly offensive. Ulcers with sharply defined edges perforate the mucous membrane of the nose, the bones become carious, the lips and eyelids become swollen, ulcerations and sloughing extend over the face, a tubercular and pustular eruption appears upon various parts of the body, and the animal speedily dies in a typhoid condition; or more slowly, worn out by the irritation and exhausting discharges, or by the gradual extension of the malady to the lungs and other visceral organs. According to Youatt the most distinctive features in the horse are the uninterrupted nasal discharge, and the early adhesion of the submaxillary glands to the adjacent structures.

Symptoms in Man.—When the poison has been received through a wound, as is most frequently the case in man, the primary symptoms are those of farcy; but unless the disease is arrested the nasal symptoms eventually appear. At intervals varying from three days to a month after the inoculation, the wound becomes inflamed, involving speedily the lymphatic vessels and glands; febrile symptoms of a low type are developed, accompanied with night sweats, the perspiration becoming after a time more profuse, sour, and offensive; diarrhœa occurs; diffused abscesses form about the large, superficial joints; the mouth and throat are parched; respiration is oppressed; eventually a shining dusky red spot appears upon the face, from which a diffused œdematous swelling rapidly extends over the nose, eyelids, and scalp; a thin fluid begins to discharge from the nostrils, which gradually becomes thick, tenacious, purulent, bloody, and offensive; tubercles, ending in ulcers form in the nares; tubercular pustules resembling the pustules of variola, but somewhat harder and smaller, present themselves upon various parts of the body, commencing usually upon the face; portions of the inflamed tissues slough and fall away; and finally low febrile symptoms, with muttering delirium, close the scene.

In case the malady originates from contact of the poison with the pituitary membranes, the nasal discharges precede the other specific manifestations, and to this form, as has already been stated in the case of the horse, the term glanders has been more especially applied. If, however, the disease begins as farcy, it invariably ends as glanders, unless arrested; and if it begins as glanders, sooner or later the symptoms belonging to farcy are presented. It is in each case the same malady, with the order of morbid events reversed. Both of these forms of glanders are occasionally characterized by milder features, and in such cases the disease may assume a chronic form. The acute disease generally terminates fatally in a few days or weeks; but in very many of the milder cases the termination is delayed several months, or a cure is finally accomplished.

The Grease.—There is a malady belonging to the horse called the **grease**, or **equinia mitis**, in contradistinction to the glanders, which latter is known sometimes as **equinia glandulosa.** In the horse the grease is characterized by a swelling of the heel, and by a thin, ichorous discharge which succeeds suppuration. This discharge being inoculated into the hands of those employed in cleaning horses, gives rise to pustules resembling ecthyma, and which were once supposed to be identical with the cow-pox, or vaccinia. These pustules begin to dry about the tenth or twelfth day, and the lesions which they occasion soon cicatrize. They have, however, very few or no points in common with vaccinia, and cannot be confounded with it.

Glanders, whether acute or chronic, must be treated by such local and constitutional remedies as the symptoms indicate. Through the whole course of the malady there exist indications for the employment of tonics or stimulants and nutrients, and the local treatment must be adapted, as in all similar examples of inflammation, suppuration, ulceration, and sloughing, to the condition in which the affected parts are found. Disinfectants, especially creosote and carbolic acid, must be employed freely whenever discharges occur; and great care should be taken, by frequent ablutions with warm water and soap and by other measures, that the discharges do not cover and infect adjacent tissues.

In order to prevent the further spread of this malady among horses, experience has shown that the most vigorous measures are required. Diseased animals must be killed and buried without delay. No horse can be permitted safely for some time to occupy the same stall or enclosure which has been occupied by the diseased horse. The blankets, harness, and especially the head-gear of the affected animal should be burned; the pails destroyed or newly-painted; the racks, ranges, and everything pertaining to the stalls should be scraped, white-washed, or painted, and thoroughly treated with soap and water, carbolic acid, or other disinfectants.

It ought not to be forgotten by the medical attendant that this disease may be conveyed not only from the horse to man, but also from man to man by inoculation; and it is quite probable that it may be conveyed through the atmosphere, by infection. The blood, also, of a horse suffering under glanders, being thrown into the veins of another animal, has occasioned the disease.

With a knowledge of these facts, the attendant will not only avoid all unnecessary exposure, but in case he has reason to suspect inoculation he will speedily resort to those preventive measures which have been recommended when wounds have been inflicted by venomous serpents.

CHAPTER X.

OTHER LOCALIZED TEGUMENTARY AND SUBCUTANEOUS INFLAMMATIONS.

Malignant Pustule. Syn.–Pustula Maligna. (R. C.) Pustule maligne; Puce malign; Puce de Bourgogne; Charbon; Anthracion; in Cattle and Sheep, Murrain; Sang du rate; Feu.

MURRAIN is quite common in certain districts of France, and in other parts of Europe; but in the United States it has occurred less often as an epizootic, and quite as rarely in a sporadic form. I witnessed, however, an epidemic of this malady in Western New York among cattle in 1843. By inoculation the disease is occasionally conveyed to man.

Symptoms in Man.—The virus is very malignant, and may be conveyed to the human system by inoculation from the hides, from the secretions, or, it is affirmed, from any portions of the body or blood of the infected animals.

At periods varying from three to eight days after exposure, a minute vesicle is formed, accompanied with an itching or stinging sensation resembling very much that caused by a flea-bite; which vesicle soon becomes livid and opens. The centre of the open ulcer in a short time presents a dark-colored, rather hard, circumscribed elevation, surrounded by a purple areola; other vesicles form in this areola, and the adjacent tissues become swollen; the itching sensation which characterized its earlier stage is replaced by a feeling of heat or burning; the swelling and induration rapidly extend, and the central portions slough; these local phenomena being accompanied by adynamic fever, which often terminates in death within a few days.

Examples of a more **benign pustule** are frequently observed, which do not originate from infection; and which, while they possess many features in common with the malady under consideration, differ from it not only in regard to specific origin, but especially in the comparative mildness of the symptoms. Nevertheless, such cases have by most writers been reported as examples of malignant pustule; but with much more propriety they might be considered as constituting one **variety of carbuncle**. They occur most often upon the lower lip, but I have met with them elsewhere, especially upon the fingers and toes.

The treatment of malignant pustule consists, first, in the thorough cauterization of the primary vesicle, and in the adoption of such measures as may be necessary to prevent the absorption of the poison into the system, which have been fully considered in connection with snake-bites; second, in the management of the local inflammation by poultices; third, in the employment of antiseptics; and finally, in the judicious administration of tonics, stimulants, and sedatives.

Carbuncle, or **Anthrax** (R. C.), has so many features in common with malignant pustule that I shall speak of it in this connection. It consists in a localized inflammation of the subcutaneous areolar tissue, of a low or asthenic character, forming a broad but circumscribed induration which results usually in the establishment of a slough. Suppuration, if it takes place, is tardy and imperfect. It is exceedingly painful, and accompanied with a burning sensation. When it occurs in old persons, and especially if it appears upon any part of the head or back of the neck, it frequently proves fatal. It is not contagious, although it is no doubt sometimes epidemic.

The first and most important indication of treatment is to improve the general condition of the system by a nutritious diet, such as fresh beef extracts, eggs, milk, and, in some cases, by the moderate use of stimulants. Iron and quinine, in small but often repeated doses, are useful tonics; occasionally sedatives may be required.

As local treatment, free incisions with the knife, and cauterization have been much practised by surgeons, with the effect generally of mitigating the severity of the pain, and sometimes of causing an abatement and limitation of the inflammation. These results are, however, by no means uniformly obtained, and incisions are sometimes followed by exhausting hæmorrhage. As a rule, therefore, when the surgeon desires to relieve the tension and strangulation of tissues in such cases, the actual cautery ought to be preferred, except, of course, when the anthrax is upon those portions of the body where the loss of structure might cause disfigurement. Emollient poultices or yeast poultices, the Savin cerate, or other mildly stimulating unguents are always appropriate.

Furunculus (R. C.), or **Boil.**—An inflammation of the skin and areolar tissue; indurated, more circumscribed, and more elevated or pointed than a carbuncle, painful, suppurating somewhat tardily, finally opening at a single point, and eventually giving exit to a small central slough, usually called the "core," after which it almost invariably terminates in rapid cicatrization.

Furunculi are most common in youth or middle life, and are dependent usually upon derangement of the digestive organs, perhaps in other cases upon certain general conditions of dyscrasy. The occurrence of a single furunculus is often followed by a succession of them, which form usually in the neighborhood of the original one, indicating apparently that the local irritation has been propagated to the adjacent tissues, although in some instances I have been convinced that the recurrence was due to the long-continued application of poultices, or perhaps of irritating ointments.

The general treatment consists in removing from the stomach and intestinal canal acrid ingesta, restriction to a simple, nutritious, but unstimulating diet, moderate exercise in the open air, and, in some cases, the administration of vegetable or mineral tonics.

The most important local treatment may be called abortive, and consists in a free puncture or incision of the minute papule or inflamed point at the earliest possible period. Surgeons have also aborted furunculi by painting them with the tincture of iodine or nitrate of silver, or by applying a small blister. My experience has led me to give preference to the knife. At a later period, the application of a small emollient poultice, and, subsequently, of the resin ointment, may protect the parts, and hasten suppuration. When this has occurred, it should be opened, and the contents be allowed to escape without pressure. From this time forward, the local treatment is practically ended, except in so far as it may be necessary to give it protection from the air and clothing.

Onychia (R. C.) or **Felon, Whitlow.**—There are several varieties of onychia, namely, **onychia maligna**, or a peculiarly obstinate ulcerative action attacking the matrix of the nail, occurring chiefly in strumous children, and demanding for its successful treatment, in some cases, the destruction of the entire matrix by either the knife or a caustic. Such cases also demand attention to the condition of the general health.

Onychia Syphilitica is an inflammation of the matrix of the nail, frequently affecting several fingers simultaneously, and presenting itself in the secondary or tertiary form of constitutional syphilis. Unlike onychia maligna, it seldom extends beyond the matrix at the root of the nail, and seldom ulcerates or suppurates. It is not apt, therefore, to cause the destruction of the nail. It has very much the appearance of an ordinary simple "run around." Its treatment consists in the employment of general means to remove the syphilitic taint, and in the local application of the tincture of iodine, or of the nitrate of silver.

Onychia Benigna may be divided anatomically into several varieties. **Onychia cutanea** (syn., paronychia, **tourniole** or **run-around**) is an inflammation of the vera cutis immediately surrounding the root of the nail, caused in most instances by a "hang-nail," or the accidental detachment of the cuticle from the free end of the lateral sulcus which receives the nail. The removal of the loosened cuticle, and the application of the nitrate of silver, or simply protecting the parts with adhesive plaster usually suffices to effect a speedy cure. In those cases in which the cuticle becomes elevated by a thin layer of serum, the cuticle should be carefully removed. The vera cutis having been thus thoroughly exposed, and having been washed with tepid water, it should then be dressed with simple cerate. If these precautions be neglected, it will be difficult to limit the extension of the vesication, and to prevent the detachment of the nail. In a few rare instances, I have seen onychia simplex occurring upon several fingers at the same time, and resembling very closely onychia syphilitica, in persons having no syphilitic taint, but who were in feeble health and badly nourished.

Onychia Cellulosa.—The most common form of onychia is an inflammation of the cellulo-fibrous tissue which composes the pulpy mass on the palmar surface of the extremity of the finger. This structure is highly vascular and richly endowed with nerves of sensation. Opposite the articulation on the palmar surface the skin is bound closely to the flexor tendons by fibrous tissue alone. It follows from these anatomical peculiarities that when the pulpy fibro-areolar tissue becomes inflamed, it suffers a species of strangulation, and the imprisoned effusions cause much pain and tension in the affected part. The extreme tension presses the blood from the integument, and gives to it that peculiar white appearance from which the term whitlow or white flame is derived. This old Saxon term is, therefore, only applicable to the form of onychia now under consideration, namely, the onychia cellulosa.

It is of frequent occurrence among kitchen maids who have their hands much in hot water, and among men who handle barrels by their chines. It occurs also from other causes, and sometimes without any apparent cause.

In the earliest stage, the inflammation may disappear spontaneously if the finger be properly protected from further injury. A little later it may demand for its arrest the application of the tincture of iodine or of a strong solution of nitrate of silver, both of which serve apparently the triple purpose of directly abating the sensibility of the surface, of furnishing a thickened cuticular protection, and of causing considerable uniform compression of the tissues when they have become thoroughly dry. In order to be effective, they must be applied to all the surfaces of the last phalanx except the nail. When the applications have become dry, a poultice may again be applied. If three or four days have passed since the onset of the inflammation, resolution is pretty certain not to occur, and there ought to be no longer delay in making a free incision, carrying the knife fairly to the bone, and this whether suppuration has already taken place or not. The omission to do so will expose to the danger of perforation of the periosteum by strangulation or ulceration, and to the necrosis and loss of the last phalanx. After the *debridement* of the tissues by the knife, the swollen pulp is apt to protrude, presenting the appearance of exuberant granulations, but in a few days the tissues retract within their tegumentary coverings, and the wound cicatrizes.

Onychia Periosteosa and Onychia Osteosa.—No doubt the local inflammatory affection sometimes commences in the periosteum, and at other times in the bone itself, but it is generally impossible to make the differential diagnosis, nor is it important to do so, since the causes, symptoms, treatment, and results are usually the same. In most cases, these deep-seated inflammations have been caused by a bruise. The symptoms consist in a deep, tensive pain existing some days before there are any external signs of inflammation, and when suppuration occurs it is almost certain to cause necrosis of the bone. The only proper mode of treatment is to make early and free incisions, so as to completely expose the bone before suppuration has taken place.

It might be proper also to make a fifth variety, the **onychia tendinosa**, or that which, commencing in the flexor tendon, or tendons, is conveyed along underneath the thecæ to the palm of the hand where their synovial structure ends. If these are not opened early, the tendons will slough, and the fingers become .contracted, unless in the healing great pains be taken to prevent this result.

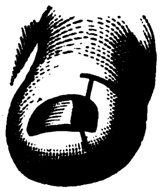
In-grown Nail, Unguis Involutus (R. C.).—Surgical writers have fallen into the common and popular error of ascribing this affection to an incurvation or to an actual growth of the margins of the nail toward the flesh, while it is due, in fact, in nearly every case to the pressing upward of the flesh against the nail. It is caused usually by wearing narrow-toed shoes, in consequence of which one toe is made to ride upon the other. Persons of a delicate or strumous constitution are more apt to suffer from this malposition than those having a vigorous constitution.

The remedy consists, first, in wearing shoes which have much closer adaptation to the natural form of the human foot than those which are usually worn; second, in the gradual insinuation of cotton under the margins of the nail. In some cases, where an irritable and painful ulceration exists, the use of the cotton should be preceded by the use of a caustic followed by a poultice, and a few days of rest in the recumbent posture.

Evulsion of the whole of the nail is an exceedingly painful operation, and is not followed usually by the best results. The new nail is never so regular and perfect as the original, and may send sharp spicula toward the flesh at the sides.

For many years, as a last and reliable remedy in these cases, I have employed one or the other of the following surgical expedients: The patient being anæsthetized, supposing the outer or fibular side of the great toe to be the seat of the trouble, an incision is made, commencing about four lines above the root of the nail, or sufficiently above to insure the removal of the matrix at the root, and about four lines from the outer or fibular side of the nail. This incision, carried down to the bone, is then prolonged to the free margin of the nail. A second incision, commencing at the same point as the first, is carried out a few lines, and then curved downward so as to include a portion of the redundant flesh, but not so much as to prevent it from covering the exposed surface when it is pressed down upon it. The intercepted portion of the nail and flesh is now dissected out, and to such a depth as to make it absolutely certain that no portion of the matrix is left. Bleeding having ceased, the remaining soft parts are pressed against the open surfaces, and secured in place with a narrow roller or adhesive strips. The same operation may be made upon the opposite side if necessary.

Fig. 34.



Operation for "in-grown" toe-nail.

In less severe cases, the alternative which I have adopted is to remove by the knife only a portion of the flesh, trusting to the cicatrization to relieve the pressure upon the nail.

CHAPTER XI.

DISSECTION WOUNDS.

The emanations from decaying animal matter are, no doubt, always in some degree unwholesome; and when highly concentrated, as may be found occasionally in closed tombs occupied by bodies which have been long dead, the gases evolved are sometimes intensely poisonous, causing, in a few instances upon record, almost immediate death, or inducing rapidly fatal typhoid fevers; but such effects are known to be exceedingly rare. As compared with the deleterious influences of decaying vegetable matter, the contrast is very striking. Indeed, dead animal matter may be intolerably offensive, and yet prolonged inspiration of the effluvia may not appreciably affect the health. The noisomeness of an odor is, therefore, no certain test of its insalubrity. M. Londe, in his *Traité Elémentaire d'Hygiène*, denies that the odors of decaying animal matter cause sickness generally; Dunglison has adopted the same opinion. Parent Duchatelet, member of the Council of Health of the city of Paris, has, however, furnished the most conclusive testimony upon this subject in his Report on Public Hygiene, published in two octavo volumes in 1836. But if testimony is needed, it can easily be obtained not alone in Paris, but in the heart or in the environs of any large city, like London or New York. I have myself visited the extensive establishment outside of the walls of Paris, where thousands of dead and dying horses, cattle, dogs, cats, and other animals are brought together into one single enclosure, and whose decaying bodies infect the air with the most disgusting odors; and can attest to the general health of the men, women, and children employed in slaughtering and handling these filthy carcasses. I have inspected equally offensive slaughter-houses, glue factories, knackers' sheds, swine yards, stables, in and about the city of New York, and while the stench has been to me often intolerable, I have never been able to discover, in the physical condition of any of the thousands employed in these loathsome pursuits evidence of the insalubrity of their occupation.

Moreover, for thirty years and more I have constantly been familiar with rooms occupied for the dissection of human bodies, most of them large, and all of them more or less offensive, and I have never seen a case of serious illness, among the students, clearly traceable to the odor of these bodies. At Bellevue, with thirty or forty tables occupied several months of the year, during the entire period that the college has been in existence, no such case has come to my knowledge.

During the late war, after many of the large battles, the stench from the carcasses of the dead horses which it was found impossible to bury, has sometimes been very great, spreading over extensive and permanent encampments of soldiers; but, while some medical gentlemen thought they detected its influence in the production or modification of certain camp diseases, the most careful scrutiny made by myself, in my capacity of United States Medical Inspector, furnished no evidence of the justness of their suspicions.

Such odors disgust, and, by association, nauseate most persons not accustomed to them; and some who are unusually sensitive can never overcome this disgust, and can therefore never become epicures to the extent of finding an appetizer in the odors of tainted venison or other putrid meats; but beyond this, very few indeed suffer any physical inconvenience.

I do not wish, in a matter which interests so large a proportion of the community, and more especially the residents of populous cities, to be misunderstood. It cannot be claimed for the odors of decaying animal matter that they are wholesome—that they actually promote good health; nor will it do to deny that when operating continuously and for a long time, they occasionally give rise to diarrhœas, fevers, and perhaps to other forms of disease; but it is safe to say that these results have been very seldom observed. If, however, such odors do not usually convey any direct septic influence, they are at least offensive to most persons, and as such they are nuisances, which the public have always a right to abate, and which no decent citizen would seek to perpetuate.

The matters introduced through wounds received in the dissection of most dead bodies, are equally innocuous with the gases exhaled from them. Very often I have wounded myself in dissection, and as often I have escaped infection. Not a dozen times have the thousands of young men who have studied anatomy under my instruction suffered serious inconvenience from a wound received in the dissecting-room; and not one has been maimed or has died. But I speak now only of the "dissecting-room" properly so called, in which the dissection of the cadaver is rarely if ever commenced until several days after death, and when putrefaction has fairly commenced. Inoculation with putrid animal matter seldom causes any more injury than might result from a similar wound made with a clean knife. In a few cases local and limited inflammation, ulceration, or abscess has ensued, and the wounds have been slow to heal. More serious results have, in similar cases, been now and then reported, and especially when the persons receiving the poison were at the time in bad health, or have had a known and peculiar susceptibility to the action of blood poisons. The observation is, however, well established, that inoculation from old and decaying bodies seldom induces a fatal septæmia, and that the more complete the decay, the more complete is the immunity; as if not only the tissues, but the poisonous secretions which occur so often just before or soon after death, were destroyed by disintegration and recombination.

Autopsy Wounds.

There is another class of wounds, however, which may properly be denominated "autopsy wounds," received in the examination of bodies recently dead, and before putrefaction has fairly set in, which has proved exceedingly fatal. Scarcely a year passes but we have to record the death of some medical man, or of some zealous student from this cause.

In some of these cases a specific virus seems to have been conveyed, the subject of the wound having suffered with the same malady as that which caused death in the person from whom the poison was received. This has been observed especially when death was caused by erysipelas or some analogous affection. But in the large majority of examples the symptoms arising from inoculation have few or no characteristics connecting them with their source, unless it be their malignancy, and the constant presence of those phenomena called typhoid. Nevertheless, it is not from all bodies recently dead that poison can be conveyed. It is only from such as have died of certain maladies; as, for example, malignant erysipelas, pyæmia, diffuse abscesses not constituting general pyæmia, cancer, peritonitis, puerperal fever, pleuritis, and perhaps a few others not named. Inoculations of the secretions derived from the peritoneal membranes have been found to be especially noxious, and I have known a medical man suffer severely from a slight wound received in the autopsy of a child who had died of pleuritis.

The inoculation may be effected through wounds inflicted by the knife, or the point of the scissors used in the dissection, but perhaps most frequently the poison has been conveyed by the prick of a needle. Sometimes a slight abrasion or a scratch upon the hand has exposed the surgeon to the infection; and in a few cases inoculation has occurred without wound or abrasion. Most men who have made autopsies must have noticed occasionally a sensation of smarting, caused by exposing the hands to the serous fluids found either in the peritoneal or pleural cavities soon after death, especially when death has been caused by inflammation of these membranes. It is quite probable that the acrimony of these fluids is in some measure an indication of their poisonous qualities.

Symptoms of Poisoning from Autopsy Wounds.—In a majority of cases the general system does not become very seriously affected; but within twenty-four or forty-eight hours after the receipt of the injury the wound is painful, the adjacent tissues inflame, and, in the case of a finger, the swelling extends as far as the hand, or even as far as the wrist; the course of the absorbents along the arm is indicated by a slight redness; one or two of the axillary glands enlarge moderately, and eventually an abscess is formed in the finger or in the hand, attended with sloughing; after which the symptoms gradually decline and a cure is slowly effected, but not perhaps without some permanent maiming of a finger or of the whole hand. During the whole progress of this inflammatory action there are the usual constitutional disturbances, such as ordinarily attend local inflammations of a like grade by whatever cause induced, but not such as imply blood poisoning, or as seem to threaten a fatal termination.

In a smaller proportion of examples, and yet not very unfrequently, the evidences of a general septæmia are made apparent by the rapid and uninterrupted extension of the inflammation to the body, by the formation of abscesses in the axilla, under the pectoral muscles, in the vicinity of the joints, and in various other regions; this grade of poisoning being accompanied with adynamic fever, restlessness, and delirium, and resulting often in speedy death.

Occasionally the same class of general phenomena have not the usual prodrome of intense local inflammation; but a slight accession of local inflammation in the wound is followed by axillary and pectoral abscesses, and by all the constitutional symptoms usually present in the examples just described.

Finally, examples are now and then reported in which the entire nervous system is brought so speedily under the septic influence that the inflammatory and suppurative stages are never completely developed, the patient falling at once into a low adynamic condition, attended with delirium or coma; death occurring within forty-eight hours, as happened in the cases of two English physicians, Drs. Elcock and Bell.

Similar phenomena, followed by serious or fatal results, sometimes ensue upon wounds received from the same class of patients in operations before death; but it is much more common for surgeons to receive wounds in operating upon disintegrating tissues, and especially upon disintegrating and suppurating bone tissues, which leave indolent ulcers of tardy and uncertain cicatrization, but which are unaccompanied with any form or degree of constitutional symptoms.

One of the most serious results of exposure to the secretions and débris of dead bodies, as well as of exposure to the secretions of living bodies affected with certain diseases of low type, is the conveyance of infection to other persons upon whom the surgeon thus exposed may have occasion to operate; the poison being conveyed either by the instruments or dressings employed, or by the hands of the operator.

It is well established that not only puerperal fever is transmitted in this manner from one female to another, but that surgeons and physicians have often introduced puerperal peritonitis into lying-in wards by attending upon a woman in labor after having been engaged in autopsies; and this notwithstanding several days have elapsed since the autopsy was made, and the hands have been often and thoroughly washed

Preventive Treatment.—In the dissection of bodies several days dead, or of recent subjects which have been injected with the sulphate of zinc, carbolic acid, or other disinfectants, no precautions seem to be necessary beyond the exercise of ordinary care in avoiding wounds; but in the dissection of bodies recently dead, not thoroughly disinfected, especially if the viscera of the abdomen or thorax have to be explored, all wounds or abrasions upon the hands should be well covered with adhesive plaster, the hands should be oiled or encased in India-rubber gloves; and if a wound is received, the part should be immediately washed, and the blood invited to flow by suction with the mouth It is generally advised, moreover, to apply at once some active escharotic, such as nitric acid, the acid nitrate of mercury or nitrate of silver, and after this to cover the part with a warm, emollient poultice. Whether it may be necessary in any given case to resort to these radical measures, can be safely left to the judgment of the surgeon.

Curative Treatment.—After a careful study of the results of the various plans of treatment which have been recommended and practised in these cases, it does not appear to me that we possess any remedies which exert a specific controlling influence over the phenomena resulting from the poison of dissection or autopsy wounds; but that, whether there are present only the ordinary and familiar symptoms of local inflammation, or the graver signs of blood poisoning, with their sequences, the treatment must be, for the present, governed by the outward and palpable indications. The inflammation, suppuration, and gangrene; the pain, restlessness, fever, delirium, and depression of the nervous system, are to be treated as similar conditions have been successfully treated when arising from other causes; and it seems only necessary to refer the reader to those various morbid processes as they have been separately considered, either in the preceding pages of this volume or elsewhere, and to remind him, perhaps, that there are no forms of blood poisoning which do not demand stimulation and nutrition, in order to assist in sustaining life until the virus can be eliminated.

CHAPTER XII.

VENEREAL DISEASES.

Of the diseases known as venereal, arising generally from impure intercourse, there are at present recognized three principal forms; namely, **gonorrhœa, chancroid, and syphilis.**

SECTION 1.—GONORRHŒA. (R.O.)

Syn.—Gonorrhœa Virulenta; Blennorrhagia; Chaude-pisse; Clap.

GONORRHŒA may be defined, inflammation of the mucous membranes lining the genital organs of either sex, caused in most cases by a specific virus, and usually accompanied with profuse discharges of mucus, or of pus. It is stated, however, that examples of gonorrhœa have been occasionally observed, called **gonorrhœa sicca,** in which no unusual secretion has appeared.

This virus is generally conveyed from one person to another in the act of venereal commerce, but it is probable that under favorable circumstances it occasionally originates *de novo*, as for example in prostitutes who are intemperate, filthy, and otherwise predisposed to disease, especially if connection is held with such a person during or near the menstrual period. There is much evidence that all abnormal or diseased secretions of mucous membranes are disposed to cause inflammation, and like secretions, upon other mucous membranes with which they may be brought into contact; so that a purulent urethral discharge in the male, caused by simple traumatic inflammation, may occasion some vaginal irritation and discharge in the female, and the reverse; but true syphilitic gonorrhœa evinces its specific character in the fact that its propagation never depends solely upon the intensity of the inflammatory action, or upon the copiousness or even upon the acrimony of the discharges.

True Gonorrhœa, or Gonorrhœa Virulenta, in the Male.

First Stage.—Generally at about the end of three days, or on the fourth, occasionally earlier, and sometimes as late as the sixth or seventh day after exposure, the patient experiences a slight sensation of itching, or of tickling, or sharp transient pains in the meatus, or of smarting after urination; and on examination he discovers a little preternatural moisture within the lips of the meatus; the moisture being due chiefly to an increased secretion of viscid mucus. The glans about the orifice may also appear appreciably swollen and reddened. In a few exceptional cases, the virus being communicated primarily to the outer surface of the glans penis, a slight redness and smarting of the glans, or of the inner surface of the prepuce, precede the accession of inflammation in the urethra.

These symptoms characterize the first stage of the disease; and by their gradual increase terminate in the second stage, in most cases as early as the third, fourth, or sixth day.

Second Stage.—Without delay or recession the inflammation, with its accompanying phenomena, advances until, at some time between the third and sixth day, the characteristic signs of gonorrhœa are fully developed; and this is denominated the second stage.

The secretion is now more abundant; and after having become at first more opaque from the presence of only a few drops of pus, it changes to a yellowish color, and is essentially purulent. Still later the pus may have a slight greenish tinge, or become reddened by the admixture of blood-corpuscles.

The glans penis and, perhaps, the prepuce become more florid and swollen, the orifice of the urethra gapes, there is a frequent desire to urinate, attended by an intense smarting or burning sensation, extending upwards an inch or more along the course of the urethra, and sometimes as far as the scrotum.

Men who have had gonorrhœa often may experience no graver symptoms than those which have been enumerated; but a first attack, especially if it has occurred in a person of a delicate, scrofulous constitution, seldom attains its climax of severity without additional complications.

The inflammation extends to the neck of the bladder, or even invades the bladder itself, causing an incessant and most distressing desire to urinate; the stream is small and forked, or crooked, and in its passage causes intense pain along the whole length of the canal; the under surface of the penis is tender from the meatus to the bladder; chordee torments the patient at night whenever he becomes warm in bed, the penis becoming erected and bridled, or curved like the neck of an impatient horse. This last symptom, which the patient is fortunate to escape, is caused by the inflammatory products which have infiltrated the corpus spongiosum, and which do not permit its injection by blood and its consequent elongation; while the corpora cavernosa, having suffered little or not at all from the inflammatory action, receive blood freely and elongate during erection as in the normal condition of the parts. It is possible, moreover, that a spasm of the muscular fibres, which, as Kölliker and Hancock have shown, exist along the whole course of the urethra, may concur with the inflammatory products in causing the chordee.

Complete phimosis or paraphimosis may occur, abscesses may form in the cellular tissue beneath the scrotum, and which occasionally make their way into the urethra and cause perineal fistulæ; the absorbents along the dorsum of the penis may inflame; the glands of the groin may become swollen, and even suppurate; the prostate may be invaded; and finally one of the testes, or its corresponding epididymis, may suddenly become painful, and suffer an acute attack of inflammation.

Gonorrhœal rheumatism is presented as a rare complication towards the close of the affection. In some of the few examples which have come under my notice I have seen reasons to ascribe its occurrence to the free and long-continued use of cubebs, balsam of copaiba, and of other active diuretics. Some late writers have, without sufficient evidence as it seems to me, regarded gonorrhœal arthritis as a variety of pyæmia.

The third stage of gonorrhœa marks the period of decline, and demands no special consideration.

Preventive Treatment.—Physicians cannot discuss the question whether it is proper to employ or to recommend preventive treatment in the case of any human malady, from whatever source derived. The same rules of ethics and of morals which would interpose objections to prevention, would equally deny the right to the means of cure; but in relation to syphilitic diseases especially, it would seem that no one ought to entertain upon this point a doubt, when it is considered that they are not always contracted in unlawful or criminal intercouse, and that their consequences may descend through several successive generations. In fact, their poisons have become so wide-spread, and have contaminated the blood of so large a portion of the human race, that, in my opinion, they are to-day retarding in a very material degree the physical and intellectual progress of man.

In many large cities of Europe, ostensibly for the purpose of preventing the spread of venereal contagions, prostitution is legalized; houses of prostitution being licensed and their inmates registered, assigned, and subjected to special surveillance and regular medical inspections. The plan is specious, and, to one unacquainted with its practical working, naturally commends itself to the judgment as worthy of imitation; but aside from the fact that by granting licenses, respectability is necessarily conferred upon an infamous profession represented by prostitutes and pimps, there remains the unanswerable objection that venereal diseases are nowhere more wide-spread or more destructive than in those cities where the system has been the longest in operation, and where it is the most rigidly enforced. Fournier, of Paris, states that of 873 cases of syphilis in men found in his wards, 625 contracted the disease from women registered by the police, and frequently examined by the police surgeons.

Gonorrhœa is inoculable at any period after infection, and for some time before the most expert medical inspectors could detect any evidence of its presence. This is certainly true of the male, as the numerous examples of husbands having conveyed the disease to their wives before its appearance upon themselves sufficiently attest; and it is probable that it is equally true of females. Indeed, I am inclined to think that at no period is the virus more active than just prior to its palpable manifestation, that is to say, on the second or third day after exposure.

There are, however, certain prophylactic measures the value of which surgeons, who have had much to do with this class of patients, understand, and which it will be proper to mention.

Long-continued exposure of the glans penis and of the delicate inner lining of the prepuce increases the thickness of their cuticular coverings, and diminishes their capacity or liability to absorb the venereal virus. Consequently, those who suffer from congenital phimosis are exceedingly susceptible of inoculation, while those whose glans penis is habitually uncovered by the withdrawal, or by natural shortness, or by circumcision of the prepuce, are much less susceptible. Immediate and thorough ablution with warm water and soap after exposure, is a prophylactic measure of some value. In order more certainly to cleanse the urethra, also, the bladder should be evacuated after washing.

It seems quite probable, moreover, that an incipient gonorrhœal inflammation may be aborted occasionally, at any period prior to its palpable manifestation, by washing the member three or four times daily with tepid water and soap, or with weak solutions of the sulphate of zinc, or of the superacetate of lead, or with any of those astringent solutions which are known to exercise a beneficial influence at a later stage. Patients have informed me that they have, by the adoption of these measures, generally secured to themselves an immunity, and I see no reason to doubt the correctness of their conclusions. I have therefore constantly advised those who have consulted me after a suspected connection, but upon whom no signs of infection have yet appeared, to employ these remedies diligently, and even to inject the meatus with a solution of sulphate of zinc, of the strength of half a grain to the ounce, three or four times daily; and in proof of their efficacy, I have at least the negative evidence, that none of these persons have ever had any urethral discharge beyond the slight increase of mucous secretion always caused by the injection itself. Ricord has designated his treatment, commenced on the day of the earliest manifestation of the disease, the abortive treatment. Although I have chosen, in accordance with a general custom, to speak of treatment prior to this period as prophylactic, it is essentially and in fact abortive, and constitutes a portion of the curative treatment, inasmuch as the disease properly dates from the first hour of exposure.

Curative Treatment.—It has already been stated that the symptomatic treatment which I have chosen to designate abortive, constitutes a portion of the curative treatment. In a large proportion of cases, however, the patient is not seen until the third or fourth day, or until there is some palpable evidence of infection. If the malady has not exceeded the moderate limits which I have assigned to the first stage, there will remain a reasonable hope that it may be arrested short of the second stage, or, in other words, that it may be aborted.

A glass or vulcanized rubber half-ounce syringe should be ordered, the nozzle of which should be sufficiently large to enable the contents to escape in a pretty full stream; and the patient should be supplied with the following:—℞. Arg. nit. gr. ij; aquæ puræ ℥iv. M. This to be used as an injection after each urination. In employing the syringe the glans penis must be seized with the thumb and forefinger so as to compress it laterally, and not vertically, and the injection must be thrown in with moderate force, since it is not desirable that it should reach beyond the fossa navicularis, where it should be retained a few seconds by compressing the glans. When the injection has been allowed to escape, a *pledget of some lint*, about one inch square, previously moistened with the same solution, must be laid over the orifice of the urethra, and maintained in place by bringing the prepuce well forward over the glans. The importance of the pledget of lint cannot be over-estimated. It effectually protects the sensitive extremity of the glans against becoming chafed; and it prevents the acrid and poisonous secretions from diffusing themselves over the glans and prepuce. In order to accomplish this the more certainly, if the secretion is copious, we should direct a *change of the lint oftener than it is required to use the injection.* Where this instruction is faithfully observed the prepuce seldom becomes inflamed or swollen, and even the glans rarely tumefies more than a few lines from the meatus. The patient must not omit to rise once or twice during the night, and use the injection, after evacuating the bladder.

At first the secretion is in most cases slightly increased, but it soon diminishes, and by the third or fourth day disappears entirely. The injections, however, must be continued a day or two after the cessation of the discharge. If, as sometimes happens, after the suspension of the injection the discharge returns, the same plan must be recommenced. A second or third trial in mild attacks is generally successful.

As to the constitutional treatment, there is no stage of gonorrhœa in which a patient can safely indulge in wines, or stimulating liquors of any kind; his food must not be highly seasoned, nor should he at any time eat to excess; but he may eat almost every variety of plain, nutritious food in reasonable quantities. Tobacco must be used sparingly, if at all. Much walking, and violent exercise of any kind, generally increases the irritation.

It is only in the case of a failure of the plan I have now recommended that resort need be had to the use of drugs internally, such especially as the balsams and terebinthinates; and I will reserve their consideration for their more appropriate place, namely, the second stage.

When the discharge becomes purulent and the urethral irritation involves the whole course of the canal, indicating that the second stage is fairly developed, very little reliance can be placed upon injections alone; yet, except in very severe cases, they are not absolutely inadmissible, and in a few cases they may be continued with actual advantage.

It is in this stage that certain remedies, sometimes designated antiblennorrhagic, exert their peculiar power; and first in point of efficacy stands copaiba, which may be given in doses varying from half a drachm to two drachms three times daily, the average dose being one drachm. In full doses it is apt to cause nausea, abdominal pains, and diarrhœa, and sometimes troublesome eruptions which most often assume the form of roseola. Its long continuance, also, occasionally gives rise to pains in the lumbar regions, in consequence, no doubt, of its stimulating influence upon the kidneys. The occurrence of either of these conditions may demand its suspension, or that the dose should be diminished. The appearance of a moderate diarrhœa is not, however, inconsistent with its happiest therapeutical effects; but if the rectum becomes excessively irritated, causing tenesmus, the urethritis is apt to be increased and extended towards the bladder.

Copaiba may be given in milk or with syrup; but owing to its nauseous taste, it is generally combined with some more palatable drug or other substance, or concealed in capsules or in sugar-coated pills. The following is an excellent formula, recommended by Dr. Bumstead: —℞. Copaibæ, ℥ i.; potassæ liquoris, ʒ ij.; glycyrrhizæ ext., ℥ ss.; ætheris nitrici spiriti, ℥ i.; acaciæ syrupi, ℥ vi.; gaultheriæ olei, gtt. xvi. Of which a tablespoonful may be taken after each meal. The pilula copaiba of the U. S. Dispensatory, composed of solidified copaiba and magnesia, being coated with sugar, is tasteless, and may be given in doses of from four to eight pills three times daily. Copaiba is most often exhibited, however, concealed in gelatine capsules, or in the form of *dragées*.

Cubebs are second only in efficacy to copaiba; and whenever the stomach or bowels refuse any longer to tolerate the latter, the former become a very reliable substitute. Cubebs are generally given in the form of the powder, one or two drachms being taken three times daily in water. They must either be freshly powdered, or well preserved in a glass vessel, since their efficacy depends upon an essential oil which easily escapes.

Alkalies are frequently serviceable during all the stages of gonorrhœa, but especially in the acute stage, by diminishing the acidity of the urine. The warm or hot hip-bath, and especially fomenting the penis and scrotum with hot water, often give relief to the burning, if they do not actually lessen the discharge.

While I cannot, from my own experience, recommend cathartics, or absolute diet or confinement to bed as at all essential to the successful treatment in a large majority of cases, nevertheless, there are a few rare and exceptional examples of very acute urethritis, in which all of these measures may be advantageously employed; but I have much oftener seen harm from the vigorous adoption of these seemingly rational means, than from their omission.

If the injections have been suspended during the more active stages of the disease, they may again properly be resumed in the third stage, or when it is fairly on the decline; and at this period the sulphate of zinc, of the strength of one or two grains to the ounce of water, has proved more efficacious in my hands than any other remedy. Indeed, a multitude of stimulating and astringent solutions have by one and another been recommended at this period, all of which seem to possess the common property of inducing a slight exacerbation of the urethral irritation, followed by a corresponding subsidence, and no one of which has probably any special or specific property; the essential point of difference being, that from long practice each surgeon adapts the strength of his own favorite remedy more skilfully to the exigencies of the case in hand. In some cases it is advantageous to suspend the injections for a few days, in order to determine whether the continuance of the discharge is not due solely to their use, and not to the presence of any degree of the original and specific inflammation.

Copaiba and cubebs are now again of less value, and ought not in general to be continued long after the second or third week, or when the decline of the disease is well established.

A good diet, moderate exercise, and tonics, especially the preparations of iron, are sometimes necessary to complete the cure.

Gleet. Syn.—Gonorrhœa Mucosa, (R.C.) Goutte Militaire; Blennorrhœa.

Gleet is characterized by a thin, mucous, or occasionally muco-purulent discharge from the urethra, of long continuance, and is usually unattended with either pain, smarting, or burning in the act of urination. It is dependent generally upon a low grade of inflammation existing in the deeper portions of the urethral canal, resulting in granulations, papillomatous or polypoid growths, or in stricture. As constitutional causes, there may be present general debility or simple impairment of the tone of the system, a strumous, rheumatic, or gouty diathesis.

A gleet, occurring as a sequence of gonorrhœa, is, in most cases, not inoculable; such, at least, seems to be the fact generally when the secretion is entirely muculent, and when a long time has elapsed since the original infection; but no surgeon can declare intercourse safe while any degree of abnormal secretion continues, inasmuch as these secretions are liable to constant fluctuations, and may at any time become more or less purulent and assume a gonorrhœal character.

Treatment of Gleet.—The local means which have been found most effectual in the cure of gleet are stimulating and astringent injections, such as the nitrate of silver, sulphate, acetate, or chloride of zinc, the bichloride of mercury, persulphate of iron, tincture of iodine, carbolic acid, to which may be added, according to the testimony of writers, a great number of mineral and vegetable solutions. As a rule, I have given the preference to nitrate of silver, of the strength of one grain to the ounce, or to sulphate of zinc of about double this strength. The injection must be thrown as far up the urethra as possible, and be repeated several times daily. Medicated bougies possess sometimes an advantage in enabling the surgeon to reach more accurately and effectively the diseased structures.

Latterly, surgeons have learned to appreciate the value of simple dilatation of the urethra with bougies, or metallic sounds. In some cases they appear to effect a cure by relieving a slight stricture, and in others by pressure alone upon the congested or granulated membrane. I have employed in most cases a polished steel sound of suitable size, introducing it once in two or three days, but Dr. Bumstead prefers bougies, tapering toward the extremity and terminating in an olive-shaped point.

Constitutional remedies are those upon which the chief reliance must be placed in this affection. It is not observed that copaiba and cubebs have any longer much influence, nor have any of the so-called specifics, if we except the tincture of cantharides, which in doses of from three to five drops daily is occasionally useful. Iron and quinine, however, are in most cases important adjuvants; occasionally in strumous habits the iodides are serviceable. When the urine is acid I have seen a gleet arrested by the tolerably free use of the bicarbonate of soda and by other alkalies. In several cases the discharge has ceased when the patient has suspended the use of tobacco; and at the same time a slight stricture has quickly disappeared.

The diet must be nutritious, but not stimulating; the patient must expose himself to the air, and adopt habits of systematic and healthful exercise; in short, he must seek by all possible means to restore the vigor and tone of the general system. A sea voyage has often accomplished a cure when other means have failed.

Gonorrhœal Complications.

Balanitis is an inflammation of the mucous membrane covering the glans penis. When the membrane lining the prepuce is inflamed it is termed **Posthitis**; and when both are involved, **Balano-posthitis.**

It is in general due to a neglect of those precautions which have been enjoined in the management of the gonorrhœal discharge. Sometimes it occurs independently of such causes. Occasionally the inflammation is attended with slight superficial excoriations, and with so much swelling of the prepuce as to give rise to a phimosis or paraphimosis.

The treatment consists in rest, frequent ablutions with tepid water the application of weak astringent solutions, and protection of the surfaces with lint moistened in these same solutions, or covered with simple cerate.

Phimosis, and **Paraphimosis,** as accidents resulting from gonorrhœa, and from other causes, will be considered under the sections devoted to Regional Surgery. The treatment is essentially the same as for balanitis and posthitis, except so far as regards the reduction of the glans in paraphimosis.

Chordee is best controlled by camphor in pretty full doses; or by camphor with the extract of lettuce; or by lupuline in doses of fifteen grains at bed-time; by bathing the genital organs in hot water before retiring; by lying under thin coverings and reposing only upon the side; by evacuating the bladder and rectum before going to sleep, and rising once or twice in the night to repeat the evacuation of the bladder. If an attack of chordee occurs, notwithstanding these precautions, the most speedy relief is afforded by stepping at once upon the cold floor.

Hæmorrhage from the urethra generally ceases spontaneously. If it persists it is to be treated by rest, cold affusions, and cold water injections, with moderate compression.

Abscesses forming in the cellular tissue must be opened early, to prevent, if possible, their communication with the canal of the urethra.

Prostatitis, both acute and chronic, and also **Cystitis,** will be more properly considered in connection with the surgical region within which the prostate gland and the bladder are situated.

Adenitis.—The lymphatic glands of the groins often become a little indurated and enlarged, but the inflammation rarely terminates in suppuration. This complication is best managed by rest alone.

Rheumatism, as the result of a gonorrhœal affection, is exceedingly rare in men, and it is doubtful whether it ever occurs in women. In two of the cases which have come under my personal observation I have had reason to suspect that it was due to the long-continued action of certain diuretics, such as copaiba and cubebs, which, being discontinued, have been followed by a very scanty secretion of urine, and coincident with this change the rheumatism has made its appearance. In most cases it presents itself in a subacute form, and yields usually to the same remedies which control rheumatic affections due to other causes.

Conjunctivitis, Sclerotitis, and **Kerato-iritis,** with a greater or less predominance of the one or the other form of inflammation, is also an occasional concomitant, or sequence of gonorrhœa; and in most cases these affections occur in connection with gonorrhœal rheumatism, and are amenable to similar therapeutical treatment.

In other cases a catarrhal or purulent ophthalmia is induced by contact of the gonorrhœal discharge with the tunica conjunctiva, which form will be further considered in connection with diseases of the eye.

Epididymitis.—In the later stages of gonorrhœal urethritis, generally as late as the fifth or sixth week, but occasionally much earlier, the inflammation passes the bounds of the urethral canal, and, extending along the spermatic duct, invades the epididymis, and may even involve the tunica vaginalis and the testicle itself. It is believed, moreover, that this accident occurs sometimes as a consequence of metastasis, or as a sympathetic irritation, and without the intervention of inflammation of the spermatic duct. In a majority of cases the left testicle is attacked; but whichever is primarily affected, the opposite testicle is seldom implicated until after the decline of the inflammation in the other. It frequently happens that the swelling of the epididymis or of the testicle disappears pretty suddenly on the return of the gonorrhœal discharge.

Ordinarily no special cause can be assigned for the occurrence of this complication; but occasionally it may be traced to over-exertion, to a debauch, to irritating injections, or to the violence done by a bougie. The omission to wear a suspensory bag is said, also, to render the patient more liable to its occurrence; and many surgeons have thought it might be traced sometimes to a sudden arrest of the discharge by certain therapeutical means.

According to Velpeau, the average duration of the acute inflammation is from sixteen to eighteen days; but the induration and more or less enlargement of the organs, especially of the globus minor, continue much longer; sometimes for many years. Epididymitis seldom terminates in suppuration. Atrophy of the testicle is an occasional sequence; and still more rarely the subsidence of the inflammation results in tubercular deposits.

The most serious and frequent result of a gonorrhœal epididymitis is obstruction or obliteration of the spermatic canal, by inflammatory products, at some point below the globus major, or in that portion where the duct is single. According to the observations of M. Gosselin, the semen of those who have double gonorrhœal induration of the epididymis does not contain spermatozoa, and they are therefore impotent. Nevertheless, these persons have the usual sexual desires and capacities, and the amount of semen discharged presents nothing unusual in color, consistence, or quantity; from which M. Gosselin concludes that the testes supply only the fecundating elements of the sperm, the spermatozoa, and that the other elements are derived, for the most part, from the vesiculæ seminales.

Under appropriate treatment the induration may disappear, and the presence of the spermatozoa in the semen again indicates that the function of the canal is restored.

Treatment of Gonorrhœal Epididymitis.—It is desirable that it should be understood that every organ of the body does not demand an entirely new and a special plan of treatment; but that the therapeutics of inflammation, while they are subject to distinct modifications, are still obedient to certain general laws, whatever organ may be attacked Writers and practical surgeons no doubt recognize the truth of this observation, but they do not always, when attempting to instruct others, speak as if they did. Thus, for example, in the treatment of gonorrhœal epididymitis a multitude of special and doubtful expedients are constantly given a prominence which they do not deserve, to the exclusion of established and most important common laws. Epididymitis has usually a spontaneous resolution, like most other acute inflammations, in from one to three weeks; but this consummation may be hastened. First, by absolute rest. The patient must be placed in bed, and kept as quiet as possible for several days. He ought not to rise even for the purpose of relieving his bladder or bowels, if it can be avoided; he certainly must not be permitted to walk across the floor or sit upright in a chair. Second, the testes must be kept elevated by a roll of soft cloths placed between his thighs while he lies upon his back, to favor the return of blood from the inflamed organs, and to prevent a painful dragging upon the sensitive cord. Third, such local applications must be made as are most agreeable to the patient, in other words, such applications as most relieve the pain. Ordinarily these have been found to be warm poultices or fomentations. According to Dr. Bumstead, whose large experience and careful habits of observation always entitle his opinions to a respectful consideration, cold applications are sometimes serviceable in the early stages of the inflammation, but I have never seen a patient who bore them well. Cold causes a contraction of the dartos and cremaster muscles, and keeps the testes in almost constant motion.

Attempts to restore the urethral discharge by bougies or irritating injections are no longer recommended; but it is not improper to continue the use of remedies to arrest the discharge in case it has not already ceased.

As to the constitutional treatment, it must be strictly antiphlogistic, and for this purpose one brisk cathartic, followed by an exclusively vegetable diet, with the permission to use freely cold water, is, in general, all that is required. During the height of the inflammation, and when the pain is most acute, small doses of morphine are admissible.

Pressure is seldom if ever advantageous in acute inflammations of any structure, and compression by adhesive plasters, by collodion or by any other means, is certainly at this stage inappplicable; on the contrary it is well established, that the removal of pressure, and the relief of strangulation, is one of the most urgent indications in all acute inflam mations. In a certain sense, therefore, the plan suggested by Velpeau of opening the tunica vaginalis whenever it is involved, and giving exit to its fluid contents, is rational; and from the same point of view, the practice which is said to have originated with Petit in 1812, and to have been revived by Vidal (de Cassis), might claim still more consideration, at least whenever the testicle itself is involved, namely, dividing the tunica albuginea to the extent of half an inch or more, by a subcutaneous incision.

Both of these operations, however, have gone into disrepute, less perhaps on account of the unfortunate results which have occasionally happened, such as alarming hæmorrhages and seminal fistulæ, than because the gravity of the operations appears to most surgeons out of proportion to the exigencies of the case. If either of the methods deserve a farther trial it is evacuation of the tunica vaginalis, by small punctures, but only when the quantity of fluid accumulated is unusually large, and refuses to be absorbed, and when the patient continues to suffer intense pain.

As to the value of pressure in the more chronic stages, when considerable induration remains, first suggested by Fricke of Hamburg, a similar judgment must be given; for while the suggestion involves a specious adherence to sound rules, in practice it is mischievous, or worthless, because it is impossible.

No organ could have been chosen more unsuited to pressure than the testicle, partly because of its excessive sensibility, partly because of its attachment to the body by a narrow pedicle, which is easily made to suffer strangulation, but chiefly because of its mobility.

In all the experiments which I have made or seen made to compress the testis or the epididymis with adhesive straps, either the cord was completetely strangulated, or no pressure whatever was made upon the diseased organ. If the cord was strangulated the suffering of the patient compelled its speedy removal, but not in several cases until active inflammation had been reawakened in the cord and testis. If it was not strangulated then it was permitted to remain, and on its removal, after the lapse of three or six days, it has been common to observe that the size of the scrotal swelling was sensibly diminished, but never have I been able to detect any change in the size of the indurated epididymis. The truth is that surgeons have constantly, I think, mistaken a spontaneous recession of the effusion lying within the loose areolar tissue of the scrotum, and which effusion composes the great mass of the swelling in most of these cases, for a subsidence of the swelling in the structure of the testis or epididymis.

If it is an effusion into the structure of the testis alone which the surgeon proposes to absorb by pressure, what means of pressure, it may properly be asked, can be devised more effective than the dense, firm, fibrous tunica albuginea, which applies itself with a smoothness and uniformity such as the adhesive plasters can never imitate.

Gonorrhœa Virulenta in the Female.

Instead of the urethra it is the vagina which in females is the usual seat of gonorrhœal inflammation; but the inflammatory lesion is not always, nor even generally confined to the vagina. The vulva is often the seat of a primary gonorrhœa; which, however, in most cases extends subsequently to the vagina; or the order of circumstances may be reversed. Effusions occur rapidly in the loose submucous areolar tissue of the nymphæ and labia, and abscesses are frequently formed, which open generally between the labia. In other cases, one or both of the vulvo-vaginal glands (called also, Duverney's, Bartholin's, or Cowper's glands) become the special seat of the inflammatory action, and give rise to abscesses, which open directly through the mucous membrane, or through the natural ducts, or may in some cases penetrate to the rectum and form vagino-rectal fistulæ. When an abscess has once formed in one of these glands it is exceedingly prone to recur upon the slightest provocation.

Vaginitis is most often the primary lesion, and may extend not only to the labia and to the urethra on the one hand, the latter occurrence being, however, quite infrequent; but also, on the other hand, to the neck or body of the uterus, still more rarely to the Fallopian tubes, ovaries, and even into the serous lining of the peritoneal cavity. In most cases gonorrhœa in the female is limited to the labia, vagina, and cervix uteri.

The lymphatic glands of the groin are seldom affected unless urethritis exists.

Treatment of Gonorrhœa in the Female.—Copaiba and cubebs have no special influence in these cases unless the urethra is affected. The treatment is therefore, in most cases, limited to the employment of such means as are known to be serviceable in non-specific inflammations of mucous membranes generally. Absolute rest, low diet, occasional cathartics, warm baths, constitute the essential parts of the general treatment. As local treatment, experience leads me to recommend especially frequent ablutions, with warm water, or if the inflammation is not intense and superficial excoriations do not exist, warm water with a little clean soap; separating the labia with a piece of sheet lint spread on either surface with fresh simple cerate; injections of warm water with or without soap, which should be thrown in while the patient reclines upon her back, and by a continuous stream, until the irritating discharges are completely washed out; and finally, after the vagina is emptied, the water injection to be followed immediately by an injection of sulphate of zinc of the strength of from two to four grains to the ounce, according to the sensibility of the parts, and the degree of smarting caused by its introduction. The same variety of astringent and stimulating injections may be employed here as in gonorrhœa existing in the urethra of the male, but their strength may always be somewhat increased.

In case the uterus, ovaries, or other internal organs are invaded, the treatment involves no special rules not applicable to inflammation in general.

SECTION 2.—CHANCROID.

Syn.—Ulcus Venereum Molle (R. C.) Simple Chancre; Soft Chancre; Non-indurated Chancre; Non-infecting Chancre; Local Contagious Ulcer; Chancre of Hebra, and Others of the Modern German School; Chancrelle of Diday.

A LARGE majority of all the venereal ulcers resulting from contagion are chancroids. In the male, its most frequent seat is the glans penis or prepuce. It may, however, be conveyed by inoculation to any part of the body; consequently it is usual to find more than one chancroid existing at the same time, from the diffusion of the secretions over the adjacent surfaces.

According to Rollet, the chancroidal virus is contained in the pus globules of a secreting ulcer; but the other secretions of the sore are incapable of conveying the malady. The pus, moreover, loses its power of inoculation sooner or later after exposure to the air, and very speedily when exposed to a high temperature, or when mixed with an acid, an alkali, or with alcohol.

It is auto-inoculable, that is, capable of being reproduced indefinitely in the person affected, by repeated inoculations from the original chancroid. This is not the case with a syphilitic chancre. In its power of propagation to other persons, also, it is not limited; but, unlike the chancre, it may be conveyed to those who have been infected with syphilis as freely as to those who have not been thus infected.

There is properly no period of incubation, but the virus takes effect immediately, as in the case of any other local irritant, yet the irritation may not be sufficiently developed to attract attention until after the lapse of seven or eight days. If the local manifestation is delayed longer than this, it is probably because there was some delay in the absorption of the poison.

When the virus has been received upon an open or abraded surface, as happens in the majority of cases, the initial ulceration corresponds in form and size to the rent or abrasion; if received originally within a follicle, a small pustule is the first palpable sign of inoculation.

A fully developed chancroid is characterized by a tendency to assume the circular form, but in this regard it is subject to modifying and controlling circumstances; by its sharp and perpendicular margins, which move freely upon the subjacent tissues; by the irregularity of the ulcerating surface, from which a copious purulent secretion is poured.

The amount of inflammatory action accompanying the progress of the ulcer is usually small; if, however, from the early application of a caustic, or from any other cause, it is increased, the sore will lose certain of its characteristic features; the whole surface may become elevated, and its edges indurated, but the induration rarely has the narrow and defined limitation which characterizes the true chancre.

The average period of advance, unless complications ensue, is about four weeks. Usually between the fifth and sixth weeks the sore begins to heal; but the cicatrization is slow, and may not be completed under several weeks or even months.

Inflammatory, or Gangrenous Chancroid.—In consequence of the severity of the inflammatory action, or of the peculiar anatomical character of the seat of the lesion, a chancroid may cause gangrene and sloughing of the adjacent tissues. This happens most frequently when the ulcer is situated beneath the fold of the prepuce, and especially in persons having congenital phimosis, or who have accidental paraphimosis. The prepuce is most apt to slough; but occasionally the glans is strangulated, and becomes gangrenous also. This process generally proves destructive to the chancroidal virus, so that thereafter the matter ceases to be inoculable.

Phagedenic Chancroid.—Without any apparent accession of inflammatory action the chancroid may exceed its usual limits, increasing in depth, and extending irregularly from its outer margins. When this hyper-ulceration is moderate, it constitutes the simplest, as it is the most common form of phagedena.

Serpiginous Phagedenic Chancroid.—In other cases the ulcerative action is more extensive, invading especially the areolar tissue, and forming long, tortuous, or serpiginous canals, above which the integument becomes thin, purple, and perforated, and finally gives way completely. This has been termed the serpiginous variety of the phagedenic chancroid; but it must not be confounded with the more superficial serpiginous ulcerations of tertiary syphilis. The serpiginous phagedena originates, usually, from a chancroid situated upon the genitals, or in the groin. It is slow in healing; but however late its cicatrization may be delayed, it never ceases to be inoculable.

Sloughing Phagedenic Chancroid, seen chiefly among the most debauched and intemperate women, is characterized by the concurrence of more or less sloughing with a rapid ulcerative action; and in both its symptoms and progress it presents a striking resemblance to hospital gangrene. Its terrible ravages among the English troops and camp-followers during the Peninsular war acquired for it the expressive name of the "black lion."

The glands of the groin become affected during the progress of a chancroid upon the penis in perhaps one case out of every three or four. Women are less liable to buboes than men. There are three forms of chancroidal buboes.

The Simple Inflammatory Bubo, or the Sympathetic Bubo.—The swelling is generally confined to one gland; the gland or glands affected seldom enlarge very much, but after continuing slightly engorged a few days or weeks, they gradually disappear. Exceptionally the inflammation results in suppuration; but the matter discharged is not inoculable.

The Virulent Bubo is due to absorption of the virus from the chancroid. It may form at any period after inoculation, but it is seldom seen after cicatrization is completed. In its early history it cannot be distinguished from the simple adenitis just described. It generally affects but one gland in one or both groins, but when suppuration takes place it is usually at two points; first, in the areolar tissue outside of the gland, as the result, probably, of simple, non-specific inflammatory action, and in so much it resembles the suppuration of a sympathetic bubo; second, in the centre of the gland itself, as the result of specific irritation. The external abscess generally opens first, and its pus is not inoculable, but if now the internal or ganglionic abscess is opened, the matter will infect all the exposed surfaces and convert the whole into a true chancroid. Moreover, the matter from the gland will cause a chancroid wherever it is inserted upon the surface of the body. It is therefore, like the original chancroid, and unlike a syphilitic chancre, auto-inoculable.

The Indolent Bubo affects often more than one gland, but seldom more than two or three. It is characterized by its slow progress, and by most of those peculiar features which attend the softening of cervical glands in persons of a strumous diathesis; to which class of glandular affections it seems closely allied, since it occurs mostly in those whose constitutions are previously greatly enfeebled. When opened it discharges a thin, flaky, and watery fluid, with little or no genuine pus.

The **Bubo "D'Emblée,"** or non-consecutive bubo, supposed to be the result of direct absorption of the virus, without the previous occurrence of either a chancroid or chancre, is now no longer recognized. A specific bubo, that is, a bubo capable of secreting inoculable pus, and capable of infecting the system, must have been preceded by either a chancroid or a chancre.

Treatment of the Chancroid.—As has already been stated, these ulcers, when subjected to no special treatment, begin to cicatrize as early as the close of the fourth week, and sometimes much sooner, and the process is completed at the end of six or eight weeks. Under judicious management, however, this period may be shortened, and complications avoided; especially is it possible to lessen the chances of absorption of the virus, and the consequent suppuration of the inguinal glands, if the ulcer is brought under treatment sufficiently early; thus, for example, if not more than six days have elapsed since the infection, thorough cauterization, it is believed, may sometimes prevent the absorption. After this period, it is not probable that cauterization, so far as the formation of a bubo is concerned, can be of any service. It is possible, however, by the same means to destroy the virus contained in the tissues composing the periphery of the sore at any period of its progress, and thus convert the chancroid into a simple ulcer, or at least so change its character as that the cicatrization will be hastened. For this purpose the most destructive caustics are, in general, much to be preferred. An old army friend, Dr. John Hammond, informs me that he has often used upon soldiers a red-hot coal with the happiest effect. The heated iron would no doubt prove equally effectual.

In both hospital and private practice I have for a long time used nitric acid undilute; the sore being first well exposed and dried, and the acid applied with the point of a small piece of soft wood. In order to be effectual the acid should be made to touch every point of the surface. When this is accomplished a piece of dry lint should be applied for a moment, and then substituted by a piece of lint moistened with some alkaline solution, to neutralize whatever acid may remain. This last may be left as a temporary dressing.

Various other caustics, such as Ricord's vegetable carbon and sulphuric acid paste, Canquoin's paste, composed of equal parts of chloride of zinc and flour, the pernitrate of mercury, sulphuric acid, the Vienna paste, etc., have been recommended by surgeons, but I do not know that either of them possesses any superiority to nitric acid. If the ulcer does not present a more healthy appearance after the slough has separated, the cauterization may be repeated.

In case it is not thought expedient to cauterize, on account of the situation of the ulcer, or for any other reason, the rational treatment will not differ from that which has been found most useful in any other simple, non-specific ulcer; except that special pains must always be taken to prevent new inoculations. For this purpose a small piece of sheet lint, moistened with a solution of the chlorinate of soda, should be laid over the ulcer, and renewed several times daily.

The inflammatory or gangrenous chancroid demands absolute rest, low diet, cathartics, and antiseptic poultices. In case of phimosis, or strangulation of the glans penis, threatening gangrene, the only alternative is to release the strangulation and expose the chancroid to view by free incisions, although it may be considered probable that the cut surfaces will become inoculated with the chancroidal virus.

All the varieties of phagedenic chancroids occur most often in persons of strumous habits, or of enfeebled constitutions; and the remedies which have proved most serviceable are such as are usually employed to combat these conditions of the system. I wish especially to enforce the importance of nutritious diet, and, as soon as the condition of the sores will permit, walking or riding in the open air.

Cauterization will sometimes arrest the progress of these ulcers, and expedite the process of healing, but such a fortunate result will be found to be rather the exception than the rule.

Treatment of the Bubo Resulting from a Chancroid.—If the adenitis is a result of absorption of the virus, suppuration is believed to be inevitable; if, however, it is due to certain unexplained sympathetic relations existing between the chancroid and the gland, suppuration is not inevitable; but inasmuch as we have no means of determining the precise cause of the adenitis, it will be proper in all cases to employ such means as are calculated to abate inflammation and prevent suppuration. Rest, cathartics, and a suitable diet, conjoined with soothing applications, may sometimes succeed. Dr. Bumstead has discussed these swellings by the application of ice at a very early period. The tincture of iodine applied externally, blisters, and other counter-irritants, have been recommended. Compression by means of a padded truss, or by a wet sponge and bandage, or by collodion was also at one time much in favor. But neither counter-irritants nor pressure have ever seemed to me to accomplish any useful purpose, while I am certain they have sometimes done much harm.

As soon as suppuration has taken place the abscess should be laid open by a free incision; and, as Dr. Bumstead properly remarks, if sinuses have already formed, they should be exposed by continuing the incisions; and such glands as are nearly isolated by destruction of the surrounding cellular tissue, and which would inevitably but slowly slough away, ought to be at once torn out by the fingers, or strangulated by a stout ligature; after which, if the general condition of the system is not greatly below the standard of average health, the sore can, in most cases, be made to granulate and cicatrize rapidly.

SECTION 3.—SYPHILIS, (R. C.)

Definition.—Syphilis is a blood-poisoning, resulting in most cases from inoculation received in venereal commerce, having a period of incubation, and manifested by certain local and constitutional signs which present themselves in a regular order or series of succession, transmissible to the offspring, and which for a period, probably as long as the virus remains in the blood, confers an immunity against a second attack.

Classification of Symptoms.

Primary Symptoms.—Including only the initial lesions, that is, the chancre, and the induration of the neighboring lymphatic glands.

The average period for the appearance of a chancre is from two to three weeks, and the period may range from ten days to five or six weeks. The superficial lymphatic glands of one or both groins invariably become indurated within twenty-one days after the appearance of the chancre, and generally much sooner, usually within ten or twelve days after the induration is manifested in the base of the ulcer.

Secondary Symptoms.—Occurring second in the order of events, characterized in general by affections of the skin and mucous membranes, and occasionally by affections of the iris, periosteum, and testes; usually transient, but only disappearing from time to time to reappear after an interval longer or shorter, or to make place for other affections of the same anatomical tissues, and in a tolerably definite chronological order.

The following table, compiled by M. Martin, exhibits the usual period of development of the most important secondary, transitional, and tertiary lesions, dating from the earliest manifestation of the chancre:—

SYMPTOMS.	Date of usual development.	Date of earliest development.	Date of latest development.
1. Roseola (erythema)	45th day	25th day	12th month
2. Papular eruption (lichen)	65th "	28th "	12th "
3. Mucous patches	70th "	30th "	18th "
4. Secondary affections of the fauces	70th "	50th "	18th "
5. Vesicular eruption	90th "	55th "	6th "
6. Pustular eruption	80th "	45th "	4 years
7. Rupia	2 years	7th month	4 "
8. Iritis	6th month	60th day	13th month
9. Syphilitic sarcocele	12th "	6th month	34th "
10. Periostitis	6th "	4th "	2 years
11. Tubercular eruption	3 to 5 years	3 years	20 "
12. Serpiginous eruption	3 to 5 "	3 "	20 "
13. Gummy tumors	4 to 6 "	4 "	15 "
14. Onychia	4 to 6 "	3 "	22 "
15. True exostosis	4 to 6 "	2 "	20 "
16. Ostitis, changes in the bones and cartilages	3 to 4 "	2 "	41 "
17. Perforation, or destruction of the velum palati	3 to 4 "	2 "	20 "

Tertiary Symptoms, or the latest form of syphilitic lesions, affecting chiefly the subcutaneous, submucous, and fibrous tissues, the bones, the viscera, and in general those structures of the body which lie remote from the surface, frequently accompanied, however, with the later forms of secondary symptoms, and more permanent in their character than early secondary symptoms.

Some writers have chosen also to speak of certain lesions as **transitional**, including, with indefinite limits, those symptoms which approach the boundary lines of the secondary and tertiary forms.

Primary Symptoms of Syphilis.

Chancre. Syn.—Initial Lesion of Syphilis; Primary Syphilitic Ulcer; Hard Chancre; Infecting Chancre; Hunterian Chancre.

Differential Diagnosis of Chancroid and Chancre.—We shall best comprehend the pathognomonic characters of a chancre by comparing them with those which belong to the chancroid.

The following constitute the chief signs of a chancroid:—1. Derived from a chancroid, or a suppurating, virulent bubo, and when inoculated artificially appears first as a pustule. 2. No period of incubation. 3. Generally multiple. 4. Ulcer perforating, with sharp and abrupt margins, not adherent; generally inclined to the circular form, often oval or irregular in outline; surface flat and perforated; secretion copious, and capable of causing new chancroids when inoculated upon the body of the patient himself (auto-inoculable); and inoculable upon others, whether they be at the time affected with syphilis or not; cicatrizing very slowly, and prone to phagedena. 5. One attack gives no immunity against a second. 6. Neighboring lymphatic glands unaffected in the majority of cases. 7. When in consequence of absorption of the virus a gland inflames it always suppurates, and its matter is inoculable, causing a chancroid; if it inflames from sympathy, suppuration is not inevitable, nor is the matter inoculable. 8. In either case but one gland is usually affected, and its progress is generally acute and comparatively rapid towards suppuration. 9. General system never infected. 10. Mercury and iodine, once regarded as specifics, never useful, and generally injurious.

The following signs, indicated by corresponding numerals, characterize a chancre:—1. Derived from a chancre, or from some other syphilitic lesion, and when artificially inoculated appears first as a papule. 2. Has a period of incubation. 3. Generally single. 4. Often a superficial erosion, possibly without induration; when it appears as an ulcer, the margins are rounded or sloping, hard, often elevated, limited abruptly in the direction of the sound tissues, adherent; form generally circular; surface concave, smooth; base and margins constitute one continuous plate of induration, forming a shallow, open cup, which is movable on the subjacent tissues; secretion scanty and serous or seropurulent, which is incapable of causing new chancres by inoculation upon the body of the patient himself (not auto-inoculable), or upon others already infected with syphilis; cicatrizing somewhat more rapidly than chancroid, and less prone to phagedena; but leaving after the cicatrization an induration which generally continues a long time; in case the initial lesion was only a superficial erosion, no induration is usually left. 5. One attack affords complete or partial immunity against a second. 6. Neighboring lymphatic glands almost invariably affected by a passive induration. 7. They are seldom acutely inflamed and seldom suppurate, but remain hard and movable a long time; in case suppuration of a gland occurs, the matter is not inoculable either upon the person himself, nor upon the person of another. 8. All the superficial glands near the seat of the chancre are, in general, simultaneously affected. 9. General system invariably affected. 10. Mercury and iodine often useful, yet possess no power to eliminate the poison from the blood, and are therefore not "specifics."

Induration of the Lymphatic Ganglia in the Neighborhood of the Chancre.—It was at one time supposed that these indurations oc cupied the extreme outermost limits of the disease as a local affection, and that the accession of febrile symptoms with cutaneous eruptions announced that the virus had passed these limits and entered the general circulation. The early ganglionic engorgements were therefore included with chancre as primary symptoms, under the belief that both were essentially local affections. The error was inevitable so long as a chancroid and a chancre were regarded as lesions of one malady, and as having a common termination in general syphilitic manifestations. If, however, as the dualists affirm, the absorption of the syphilitic virus and the infection of the blood follow immediately upon the inoculation, the disease is never localized, and the so-called primary symptoms are as essentially constitutional as the secondary symptoms.

If we speak then of a period of incubation, it is not intended to say that the virus is detained at the point of inoculation or in the glands, but that its evolution or reaction, after being received into the general system, is delayed for a period.

In the earliest period of a chancre there may be no induration, and it is possible even that a superficial chancrous erosion may cicatrize without induration, while in very many of these examples the plate of induration is so thin and parchment-like that it may escape detection, but in some degree it is so constantly present as to constitute one of the most important signs of syphilitic infection. The absence of induration may not prove conclusively that no syphilitic virus has been conveyed to the blood, but its presence demonstrates not only absorption but constitutional reaction, of which this is usually the first manifestation. In the same manner, also, ganglionic engorgements, which are delayed only a few days after the appearance of induration in the chancre, and probably are sometimes synchronous, are only additional manifestations of the constitutional reaction. Usually this symptom is clearly observed within ten or twelve days after the first appearance of induration in the chancre; all, or nearly all, the superficial glands of one or both groins undergoing a passive enlargement, but probably in not more than two or three cases out of a hundred does the enlargement end in suppuration.

It is proper to remark that the occasional omission of a symptom never destroys the identity of a disease; nor is the argument of the dualists at all weakened by the admission that general syphilitic infection may exceptionally occur without its having manifested itself by induration of the chancre or of the glands.

Treatment of Primary Symptoms.—It is only by careful experiment and observation that surgeons have reached the conclusion just stated, namely, that the syphilitic virus is never limited within the tissues immediately adjacent to the sore. It may not be positively established that it is never thus localized prior to the appearance of the erosion or ulcer, but it is demonstrated that the most complete destruction of these tissues within a few hours after their appearance fails to avert the constitutional infection, and for practical purposes this is all that need be known. It would not be possible to indicate at an earlier period the point of inoculation, and later, so far as the general results are concerned, cauterization or exsection is useless. If caustics are then to be employed in any of these cases, it must be in pursuance only of those general principles which govern the local management of other ulcers, and with the view only of hastening cicatrization. These principles have already been announced in connection with non-specific ulcers, and especially in the section which treats of chancroids.

Mercury, in all of its forms, possesses the power of hastening the cicatrization, of dispersing the induration, and of delaying and probably modifying the subsequent manifestations of general infection. It should be given in moderate doses, and continued until its specific effects are observed; but great care should be exercised not to cause ptyalism, which is never useful, and rarely fails to do harm.

Iron and other tonics, combined in certain strumous cases with iodine in small quantities, may be required to maintain the vigor and tone of the system.

The same general remedies may affect favorably the ganglionic indurations, yet these are known to continue in many cases long after the induration at the seat of the chancre has disappeared.

Secondary Symptoms of Syphilis.

It is difficult to define precisely what is meant by secondary symptoms. Hunter's classification was based upon the anatomical characters of the tissues affected, and the chronological order of the symptoms. Ricord modified this classification, by including the questions of general infection, inoculability, hereditary descent, and the effects of treatment. Virchow and others have proposed a classification based upon the nature of the pathological changes alone. Each method is liable to serious practical objections; and for myself, if I were to add anything to the definition already given in the opening of this chapter, it would be a chronological limitation, which, if it could not be applied rigorously, any more than the definitions chosen by others, would at least possess the merit of simplicity. Referring to the table of M. Martin, already given in the preceding pages, I would include in the secondary lesions all those (10) whose earliest date of appearance is one year or less, excluding, of course, the primary lesions: the remainder (7) being regarded as tertiary.

The various forms of **syphilodermata** differ somewhat from their non-syphilitic analogues. The redness attending the roseolar affection and most of the other exanthems is dusky, inclined to brown, or, as it is usually termed, "copper-colored," and on disappearing they leave brown stains; all the varieties are disposed, more than other exanthemata, to assume circular, crescentic, or serpiginous forms; the crusts are darke and heavier.

Roseola consists of dusky red patches of various sizes, usuall presenting themselves first upon the abdomen. It is generally a sequel of that form of chancre which appears as a simple erosion; unless arrested sooner by treatment, it generally remains several weeks or months.

Papulæ.—Small, solid elevations of the outer layer of the derma, frequently seen upon the forehead, but not to be confounded with acne. There are three varieties, namely, the conical, the lenticular, and the miliary, upon the summit of the last of which is seen generally a minute vesicle containing serum. When not interfered with by treatment they usually continue one or two months.

Squamæ, (**Syn.—Pityriasis; Psoriasis; Lepra Syphilitica**) in most cases, a sequel of roseola, papulæ, pustulæ, vesiculæ, or of tuberculæ; characterized by colored patches, sometimes smooth and shining, covered with thin scales of epidermis, which are constantly falling off and being reproduced; occurring most frequently upon the scalp, upon the inside of the arms and thighs, upon the scrotum and penis, and upon the palms of the hands and soles of the feet. Several varieties are described, such as the *guttata*, *diffusa*, and *lepra*, the latter of which appears usually in a circular form like herpes circinnatus.

Vesiculæ are a rare form of syphilitic eruptions, occurring most often upon the face, back, and extremities. They do not present a uniform appearance, but may resemble varicella, eczema, or herpes. Syphilitic *bullæ* are vesicles of large size. One variety of bullæ called *pemphigus* is rarely seen except in infants affected with hereditary syphilis. The *rupiæ* are also regarded by some writers as belonging to the bullæ, and by others to the pustulæ.

Pustulæ are very common, especially upon the scalp; but they may extend over the whole body, and are seen quite often upon the extremities. They commence usually as papules, but soon form pustules, surrounded by copper-colored areolæ. *Acne syphilitica*, a variety of the pustulæ, is characterized by a small pustule upon a prominent base, and unlike acne simplex, it is not limited to the face and upper portions of the body. *Impetigo syphilitica*, another variety of the same affection, is known by the flatness of its pustules, and the grayish or greenish-yellow color of its crusts. It is frequently seen around the alæ of the nose and in the beard. While the *ecthyma*, which is the most frequent form, consists of an eruption of large size, flattened also, and upon which heavy, laminated crusts are formed, often pyramidal, of a dark color, and known as *rupiæ*.

Mucous Patches.—It is probable that every variety of cutaneous affection has its counterpart in the mucous membranes. The analogy and coincident occurrence of many of these forms is sufficiently established; but they are always somewhat modified in appearance, and fe this reason their relations to their analogues are not in all cases easily determined. Roseola is represented by irregular and diffused patches of a bright red color, sometimes whitish in the centre, most frequently seen upon the posterior part of the roof of the mouth, and upon the velum. They are usually transient, or at least disappear as soon as the corresponding cutaneous affection. The papular eruption is represented by small, flattened elevations of the mucous membranes. The vesicular and pustular coincide with the various forms of ulceration affecting mucous membranes. Late writers have, however, reserved this name for those lesions which consist in most cases of round or oval and quite broad plates of hypertrophied mucous membrane, or perhaps, to speak more precisely, of hypertrophied papillæ, generally of a rose color, seen most frequently upon the mucous membrane of the mouth, or sides of the tongue, around the anus, or within the vulva. They discharge from their surface, usually, a thin ichorous matter which is inoculable.

These patches last described have been called by writers, *mucous tubercles*, *mucous pustules*, *mucous papules*, *and condylomata*, especially when they appear about the anus or vulva.

Iritis and **orchitis**, or **syphilitic sarcocele**, will be considered hereafter in connection with the other maladies to which the eye and testicle are respectively subject.

Periostitis in a mild and fugitive form is a frequent accompaniment of the earlier, or secondary forms of syphilis. It is more persistent and grave at a later period, and will be considered in connection with the tertiary symptoms.

Alopecia, also, frequently precedes or attends the first manifestation of the exanthemata, but in this case the hair is usually restored after the eruption has disappeared; but when it occurs later the hair follicles wither, and permanent baldness is inevitable.

Onychia Syphilitica, consisting of inflammation of the matrix of the nail, and consequent loss or disfigurement of the nail itself, is an occasional attendant upon both secondary and tertiary syphilis.

Treatment of Secondary Symptoms.—A pretty large experience in the treatment of syphilis, both in private and hospital practice, and especially in the extensive venereal wards of Charity Hospital, has convinced me, contrary to the prevailing opinion among syphilographers, that in every stage of this malady, in the primary and secondary not only, but in the transitional and tertiary also, there are circumstances under which mercurials are useful; and moreover, that in each of these stages there are conditions under which it is not only not useful, but in which it is absolutely pernicious. In general it may be said that persons of a highly strumous diathesis do not bear mercurials well; and that all of those forms of syphilis in which there is extensive ulceration, phagedena, or sloughing are intolerant of mercury, concurring with which conditions, it will be observed, there is usually mal-assimilation, anæmia, and general debility; and finally most cases of syphilitic affections of the bones. On the other hand, with the exceptions named, both primary and secondary symptoms generally yield to mercury; quite often transitional symptoms demand mercury; and occasionally, even such tertiary symptoms as necrosis and caries, especially of the spongy bones of the nose, cannot in any way be arrested so promptly as by the judicious administration of this medicinal agent. But in all forms of tertiary symptoms mercury must be used with more caution than in the secondary forms, always in minute doses, never to the production of ptyalism, and rarely should its use be continued for any great length of time.

Bumstead, in so far as regards the accidents belonging to the secondary and transitional forms of syphilis, has expressed a somewhat similar opinion. Limiting the secondary accidents to those superficial eruptions which terminate in desquamation, namely, the erythemæ, papulæ, squamæ, and vesiculæ, he affirms that they require the use of mercury. He does not make any exceptions, however, in favor of highly strumous patients. While, he adds, "the deeper eruptions, attended by suppuration and ulceration," pustulæ, tuberculæ, etc., belonging to the stage of transition and to the tertiary period, demand iodine in conjunction or alternately with mercury.

The successful administration of mercury depends then, first of all, upon the judicious selection of the cases. During the period of primary symptoms, and in the earlier stages of secondary symptoms, there is usually no contra-indication for its use but an intensely strumous habit or a constitution completely wrecked by dissipation or other causes. Second, success depends less upon the particular form of mercury, than upon the care and judgment exercised in its administration. Its best effects are incompatible with the production of febrile reaction, ptyalism, diarrhœa, nausea, impairment of appetite, or even a general malaise. To avoid these results it must be introduced gradually and slowly into the system, with occasional brief intermissions, in order that any accumulations in the stomach or intestinal tube may have time to be discharged. Manifest improvement in the specific symptoms ought to be accepted as evidence of its constitutional influence, and lead to its suspension.

Tertiary Symptoms of Syphilis.

Tertiary symptoms are usually, but not in all cases, separated from the secondary symptoms by an interval of apparent health. The application of the term "tertiary" has been sufficiently explained at page 160. It includes, as will be observed, certain lesions of the subcutaneous structures, such as subcutaneous tubercles, and some others, which have, in common with the later forms of secondary symptoms, been denominated "transitional." It is sufficient to say of this subordinate division of syphilitic symptoms, namely, the *transitional*, that their treatment demands at times both mercury and iodine.

Tuberculæ.—Syphilitic tubercles are solid elevations, occasioned by deposits within or immediately subjacent to the derma. They are larger than papulæ, have a greater tendency to ulceration, and occur much later. Their most frequent seat is upon the face, and next in point of frequency they occur upon the body and extremities.

The so-called *serpiginous eruptions* belong to the variety just described, namely, the tuberculæ. The name only indicates the serpiginous lines in which the groups of tubercles often arrange themselves; when ulceration has taken place, they receive the name of *syphilitic tubercular serpiginous ulcers.*

Gummy Tumors. **Syn.—Gomme Syphilitique.**—Syphilographers have given the name of gummy tumors to certain deposits which belong more especially to the tertiary form of syphilis; occurring in the subcutaneous cellular tissue, in the muscles, tendons, periosteum, bones, testes, heart, and in various other structures of the body; characterized, when situated beneath the skin and mucous membranes, by tumors which form slowly and are for a time movable, but which, having attained the size of a filbert, or, in some cases, the size of a hen's egg, become discolored, suppurate, and finally discharge an ichorous pus. The anatomical elements, according to Robin, are chiefly cytoblasts, fusiform fibro-plastic bodies, and a finely granular, semi-transparent amorphous substance. These elements are not peculiar to the gummy tumor; indeed, they are found equally in the tuberculæ, and there seems no good reason why the gummata should not be admitted under the same classification, since they differ chiefly in the relative amount of the gummy or tubercular deposit. Virchow sought to base upon the absence or presence of this material a distinction between secondary and tertiary symptoms, or between active and passive syphilis, and which would equally determine the limits for the employment of mercury and iodine.

It will be understood that neither here, nor when speaking of the tuberculæ, is the word tubercle employed as synonymous with the tubercle of phthisis, between which there are several points of difference.

Periostitis, a common attendant upon secondary syphilis, is more constant and persistent in the tertiary form. It is preceded usually by osteocopic pains, which continue through the whole course of the periosteal inflammation, and which are especially severe during the night. It attacks usually the superficial bones, such as the cranium, the clavicle, the radius or ulna, and the spine of the tibia. The epiphyses and joints are also occasionally invaded. Effusions soon occur, causing hard, smooth swellings called *nodes*, which are not much disposed to suppurate. Occurring upon the forehead, they have received the suggestive title of *corona veneris.*

Ostitis and hypertrophy of the bones, with condensation of the osseous tissue, is not very uncommon.

Necrosis is most common in the bones of the nose, the superior maxilla, and outer plate of the skull.

Caries occasionally accompanies the necrosis, but I have seen it unaccompanied by necrosis in the upper epiphysis of the tibia, and in the soft, spongy bones of the tarsus, where it is usually preceded by some of the forms of cutaneous ulceration, especially the serpiginous.

Venereal Warts or Vegetations are papillomatous growths, in other words, examples of hypertrophy of the papillæ, found especially upon the mucous membranes of the penis, vulva, and anus, occurring sometimes as sequelæ of gonorrhœal balanitis or posthitis, at other times rising upon the cicatrix of a chancroid or of a chancre, and occasionally following a simple non-specific herpes, or an ordinary leucorrhœal discharge. They cannot therefore be considered as essential or diagnostic symptoms of syphilis.

Treatment of Tertiary Syphilis.—Iodine, in some of its forms, enjoys a reputation for the treatment of tertiary symptoms, quite equal to that enjoyed by mercury in the primary and secondary symptoms. Indeed, to speak the truth, iodine has in this regard the advantage, since there are none who doubt its efficacy in what is considered its special rôle, namely, in tertiary accidents, while there are many who question the efficacy of mercury in any form of syphilis.

Iodide of potassium, the form in which iodine is now generally employed, is much less liable to disturb the stomach than the tincture of iodine. The average dose is about five grains three times daily, and continued for an indefinite period. If the symptoms do not yield, the dose may be increased to ten or twenty grains. Latterly some surgeons have recommended its use in quantities of one hundred or more grains per day, and speak of the practice as safe. The evidence which has been presented to me does not sustain this conclusion.

Every possible means should be employed to improve the general condition of the system, such as the use of tonics, mineral or vegetable, good diet, fresh air, and exercise. Nitric acid once occupied a position in the public estimation very similar to that now held by iodine. I have used it much in my early practice, and can attest to its value as a tonic in the latter stages of this disease. It should be given in doses of from three to six drops three times daily, sufficiently diluted with water. The nitro-muriatic acid in similar doses, properly diluted, is perhaps equally efficacious.

I have already said that there are examples of tertiary syphilis constantly presented, in which mercury alone will arrest the progress of the local accidents. Thus, for example, it is not uncommon to see cases of tertiary iritis, tertiary ulcerations of the tongue and larynx, especially when these ulcerations are deep and have originated in tubercular deposits, serpiginous ulcers upon the extremities, nodes, and finally, cases of caries or necrosis of the bones of the nose or of the superior maxilla which are not arrested by the iodides, but which speedily assume a more healthy action, or are completely arrested, under a moderate course of mercury. Mercury is therefore, in my judgment, the most reliable remedy for syphilis yet discovered, to which the iodides hold a secondary and subordinate rank. If with these remedies we cannot guarantee a cure of syphilis, or even determine the limitations of its external manifestations, I am confident we are able to shorten and ameliorate the duration of the symptoms as they arise from time to time, and hasten the period when the poison shall be thoroughly eliminated. That is to say, under favorable circumstances, by the aid of these agents, we may generally sooner or later effect a cure.

Tegumentary ulcerations and ulcerations of mucous membranes are to be treated, so far as local applications are concerned, as if they were not specific. The crusts of rupia must be carefully removed by poultices, in order that ointments may be applied directly to the ulcerated surfaces.

In periostitis the dispersion of the inflammation and induration is sometimes expedited by the application of tincture of iodine; but a blister is more likely to prove efficacious. If the swelling and pain persist, and especially if suppuration is inevitable, they should be opened by long and free incisions to the bone. This, however, ought never to be done until iodine has been thoroughly tried in large and long-continued doses; nor unless the pain is great, or the danger of the formation of pus is imminent, or its presence is already well determined.

When necrosis occurs, the dead bone should be removed as soon as its detachment is complete; but the process of separation in syphilitic necrosis is often very slow.

Syphilization, or Treatment of Syphilis by Repeated Inoculation.

In 1850, M. Auzias Turenne announced to the French Academy that by repeated inoculations of the syphilitic virus he had been able to cure the most inveterate forms of syphilis; and moreover, that by similar repeated inoculations practised upon those who had never contracted syphilis, he was able, without hazard to themselves, to secure to them immunity against any subsequent infection.

These statements were at first received with derision and denunciation. Since then, however, a large number of experimenters believe that they have confirmed the accuracy of M. Auzias' observations; and while they have not seen fit to continue to urge the claims of this method as a prophylactic, they insist upon its value as a means of cure. The most prominent among those who hold these opinions is Prof. Boeck, of

Christiania, Norway. The following constitute the chief points of the new doctrine as taught by Prof. Boeck.

1. There is but one form or genus of syphilitic disease; the chancroid and chancre only representing different forms or varieties of the same malady.
2. Syphilis is cured or rendered latent by change of organism.
3. Mercury and iodine cure only symptoms. They do not therefore cure the disease; they rather tend to prevent its cure.
4. Both chancroids and chancres are auto-inoculable.
5. It is not proper to commence inoculation until constitutional symptoms are present.
6. It is not of so much value if the patient has taken mercury.
7. The auto-inoculations should be continued until they fail to produce pustules.
8. Each successive crop of pustules will be smaller than the preceding; but they will become again somewhat larger when the inoculations are transferred to another and remote part of the body; or again, finally, when virus is taken from a sore upon some other person; but these new pustules will also become smaller by successive inoculations, and will not pass through so many generations as the first series of inoculations. At last no syphilitic virus will cause an ulcer.
9. These inoculations should be repeated at first on every third day, the new inoculation being made from that immediately preceding; but towards the last, or when they cease to take, the inoculations should be made every day, or as often as may be necessary to keep the patient continually under the influence of the inoculations.
10. Successful inoculation requires usually that the sore from which the virus is taken shall be discharging pus, and that the patient inoculated shall not be suffering under any acute disease, or be in a condition of pregnancy.
11. Glandular indurations are caused by inoculation, but the glands seldom ulcerate. The health of the patient generally improves under the process.
12. Relapses sometimes take place—that is, secondary and tertiary symptoms may occur, but not in a larger proportion than 13 per cent., while by other methods of treatment the proportion is as high as thirty-three per cent.
13. Syphilization does not prevent hereditary descent of the diathesis.
14. Syphilization is equally applicable to inherited syphilis as to acquired.[1]

During the visit of this distinguished Norwegian physician to our country in 1870, I had several opportunities of witnessing the progress and results of syphilization practised by himself upon patients laboring under secondary and tertiary syphilis; and while I do not consider the observations as sufficiently numerous to justify me in expressing an opinion as to its general efficacy and value, I am compelled to say that in each instance the improvement was unmistakable, and that in one or two extremely bad cases the progress toward recovery was remarkable.

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[1] Boeck. *American Journal of Syphilography and Dermatology*, Jan., 1870. Communicated by Prof. Boeck.

Hereditary Syphilis.

The syphilitic diathesis may be conveyed directly from the male parent through the sperm to the offspring, without the intervention of disease on the part of the mother. In like manner, through the medium of the blood, it may be conveyed from the mother to the child also, although she may not be at the time laboring under any primary or other form of inoculable sores. It is probable, moreover, that having been conveyed by the male parent through the semen to the fœtus, it may be reconveyed from the fœtus *in utero* to the mother.

The virus of syphilis may be thus conveyed at any period of the primary or secondary affection, and probably, also, during any period of the tertiary affection; but the symptoms present in children born of parents suffering under tertiary syphilis, or of parents who have once been infected, but are at the time of conception supposed to be cured, bear usually a closer resemblance to scrofula than to syphilis.

Hereditary syphilis may not be present in the first child born after the diathesis has been acquired by the parents, and yet it may manifest itself in the second, or even later. Such cases, however, are exceptional.

If either parent is affected with syphilis at the time of conception, both the fœtus and the placenta are liable to become involved in pathological conditions which lead to their expulsion.

A child may also contract syphilis from contact with inoculating sores in its passage through the vagina, or it may contract the same from primary or secondary lesions upon the breast of the wet-nurse. It has been believed, also, that the disease may be transmitted through the milk of an infected nurse.

Children suffering under syphilitic intoxication often appear healthy and robust at birth; but the eruptive affections are seldom delayed beyond three months, and they generally appear within the first month. In very rare and exceptional cases, the period of development may be extended to one year. It is even possible that the virus may remain latent many years after birth.

The infant affected with hereditary syphilis becomes emaciated, his skin wrinkles and acquires a peculiar sallow or bistre tint, giving to his features the appearance of premature age; he is affected with coryza, and mucous patches occur upon the various mucous outlets of the body. Roseola and the other forms of erythema are rare; so also are the non-ulcerating tubercles, the papulæ, the squamæ, the periosteal and osteal affections; but pustules and pemphigus, the latter of which is so seldom seen in adults, are quite common.

Certain characteristic pathological changes are seen also in those infants who have died early or been found dead at birth, especially in the thymus gland, the liver, and the lungs.

The temporary teeth of syphilitic infants are usually defective and discolored; they appear early and decay prematurely; but the permanent teeth present the most characteristic indications of the syphilitic taint, especially the central incisors of the upper jaw, which are short, discolored, peg-shaped, generally inclined towards each other, and marked by a deep concave notch on their free margins.

Treatment of Hereditary Syphilis.—Mercury given in minute doses is most to be relied upon, provided always that it causes no disturbance of the stomach or bowels. The hydrargyrum cum creta is the best form, given in doses varying from one-sixth of a grain to half a grain three times daily. If the stomach does not bear well the internal use of mercury, it may be employed externally as an inunction.

CHAPTER XIII.

LESIONS OF THE NERVOUS SYSTEM.

TETANUS, (R. C.)

THERE are two forms of this malady, differing more in their mode of causation than in the symptoms by which they are characterized. They have been named idiopathic and traumatic.

Idiopathic tetanus is that form which arises from general, constitutional, or internal causes, and has no dependence upon a wound or external injury. These causes are substantially the same with those which, when found to precede or accompany traumatic tetanus, are called "predisposing." Among them have been enumerated cold, dampness, heat, and dysentery. It has been known to be occasioned by gastritis, intestinal ulcerations, hernia, pericarditis, pulmonary abscess, disease of the mammæ, uterine irritation, an emetic, nux vomica, cicuta, and various other acrid poisons.

There is a variety of idiopathic tetanus, also called trismus nascentium, trismus infantum, or "nine-day fits," which is common and exceedingly fatal in the West India Islands, and in the Southern States of our confederacy, especially among the negro children. In the rocky Vestmann Islands, on the south coast of Iceland, with a population of only one hundred and fifty persons, one hundred and eighty-six infants perished from this cause in the space of twenty-five years. Dr. Joseph Clark says that in the year 1782, of 17,550 children born in the Lying-in Hospital of Dublin, 2,944 died from this cause alone within the first fortnight after birth. Its most frequent causes are insufficient or unwholesome milk, filth, and exposure to inclement weather. We have seen it occasioned in one instance by a dose of castor-oil. It is said also to be produced sometimes by injury sustained in the ligation of the umbilical cord. These latter examples must be regarded as traumatic.

Traumatic tetanus, or that which originates directly from a wound, is divided into acute and chronic, of which the former is much the most frequent. It might be more proper to regard these two forms as only different degrees of the same malady.

The causes of traumatic tetanus are predisposing and exciting.

The predisposing causes are mental depression, climatic influences, such as excessive heat, sudden vicissitudes of weather, and especially a rapid change from hot to cold and damp weather,—it is more frequent in spring and autumn than in summer or winter,—exposure of a portion of the body to cold drafts of air, an irritable temperament, physical exhaustion, disorder of the stomach or bowels, a scorbutic taint, etc.

The exciting causes are wounds, especially compound fractures, in which spicula of bone press upon nervous trunks; wounds accompanied with unhealthy suppuration, gangrenous sores, or those which from neglect are not kept properly cleansed; laceration, contusion, partial division, or the ligation of a nerve.

It has been known to be occasioned by cutting a nail or a corn too closely, by stubbing the toe, by abrasion from wearing tight boots, by a wound of the gums, by a laceration of the fourchette in labor, by the sting of bees, by the stroke of a schoolmaster's ferule, by salivation, the introduction of a seton, the injection of a hydrocele, the lodgment of a fish-bone in the fauces, the application of a scarificator in cupping, the ligature of arteries, ligature of the umbilical cord, burns, and the excision of tumors. In one instance we have known chronic traumatic tetanus occasioned by the prick of a needle.

Gross observes that the effect of cold air in the production of tetanus is well illustrated by an occurrence which took place after the battle of Ticonderoga, in 1758. The wounded were exposed, the whole night after the action, in open boats upon Lake George, and the consequence was that nine of them died of this disease. During the war of 1812 "most of those wounded by fire-arms on board the frigate *Amazon*, before Charleston, were attacked with tetanus on the fourteenth day;" the weather, which had been warm and dry, having changed suddenly to cold and wet.

Dr. Miner, of Buffalo, in a paper on Tetanus,[1] informs us that, according to the United States Census returns of 1850, the recorded examples of tetanus in the several States during the ten preceding years presented the following remarkable contrasts. In the 6 New England States, 19 cases; New York State, 23,—total 42. While in the southern tier of States, lying adjacent to the Gulf of Mexico and to the mouth of the Mississippi, 23 occurred in Georgia; 6 in Alabama; 60 in Mississippi; and 215 in Louisiana. "Of the whole number in the United States, 694, there were 367 among children under one year of age, this including the negro children who died of trismus nascentium."

The period of incubation, or the period which elapses between the receipt of the injury and the invasion of the disease, varies from a few hours to several weeks, but its most common period of invasion is from the third or fourth to the twenty-second day. Sir James McGregor says it never appears after the twenty-second day, but several cases on record prove the incorrectness of this statement.

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[1] Miner on Tetanus.—*Buffalo Medical Journal*, March, 1859.

The premonitory symptoms are rarely of a character so definite or peculiar as to indicate plainly the accession of this malady. In some cases the unhealthy appearance of the wound, increased pain, twitchings of the muscles, mental depression, wakefulness, and a general *malaise*, might awaken a suspicion; but these circumstances, so common in the history of most severe injuries, could not properly be relied upon as indications of the approach of a complication so exceedingly rare. Pain, or simply at first a sensation of oppression in the præcordial region, is often present in the earliest stage of the malady, but it is by no means so constant a prodrome as some writers have supposed.

The symptoms which characterize its actual accession are fugitive pains and stiffness about the muscles of the face and neck, observed first, in most cases, upon the side corresponding to the wound. The patient is unable to open his mouth freely, the angles of the mouth and eyes are drawn aside, he swallows with some difficulty, especially fluids, and the muscles of mastication are rigid.

When the disease has progressed no farther than this it is called trismus, or lock-jaw, and in mild cases it is sometimes arrested at this stage.

More often, however, the disease steadily advances; a severe and fixed pain shoots from the ensiform cartilage to the back, accompanied with difficult and convulsive breathing, in which the muscles of the glottis are also implicated; the walls of the abdomen are hard, the bowels constipated; urination is difficult. Sooner or later all the muscles of the body become rigid, constituting true tetanus; or the muscles of the back being most violently contracted, the patient rests only upon his head and heels, a form of spasmodic contraction which is termed opisthotonos; more rarely the incurvation takes place in the opposite direction, constituting emprosthotonos; and still less frequently a lateral incurvation is observed, which has been called pleurosthotonos.

In well-formed cases these spasms may occasionally relax, but they never completely cease. The pupils are contracted, froth escapes from the mouth, while the teeth remain firmly closed; and in the distorted features, agony, pain, and despair alternate with sardonic smiles. Obstinate and persistent constipation is invariably present.

The pulse, except when accelerated by the violence of the spasms, remains undisturbed. But the most appalling circumstance of all is the fact that, during this frightful agitation of the body, the functions of the brain are generally unimpaired, and, like a mariner in the midst of a storm, the mind of the sufferer is the conscious witness of the writhing and tossing of the vessel whose speedy wreck seems inevitable.

As the case approaches a fatal termination the paroxysms become more frequent and violent, and the breathing more embarrassed, until at length the patient dies in a state of exhaustion or of suffocation.

Death generally takes place on the third or fourth day, sometimes as late as the eighth, tenth, or twelfth day; but if life is prolonged beyond this, recovery may generally be anticipated. Occasionally it has been observed that the spasms commence, and are throughout more violent upon the side corresponding to the wound; and still more frequently it is noticed that, in the early stages, the spasms are confined to the muscles in the neighborhood of the wound.

The prognosis in these cases is always exceedingly unfavorable. Hennen says he has never witnessed a cure of acute traumatic tetanus, but in some examples of the chronic form he has seen a relief accomplished. The distinction made by Hennen and others between the acute and chronic forms is, as we have before intimated, arbitrary and unnecessary. They constitute, in our opinion, degrees of the same malady; and to judge of the curability of the affection, we must consider them as one.

Of 23 cases reported and tabulated by Macleod as having occurred in the Crimea, 2 recovered. In the records of the army in India, Macleod found 19 cases, of whom 1 recovered. Alcock reports 17 cases, of whom two recovered. In the Egyptian campaign reference is made to more than 30 cases; "all seem to have died within a week of the appearance of the symptoms." In the German campaign of 1866, "several are recorded as having recovered after section of the nerve."

During our late war 363 cases of traumatic tetanus were reported to the Medical Bureau at Washington, of which number 336 terminated fatally. Of the 27 recoveries, the disease was of a chronic character in 23.

I have myself met with 21 cases of traumatic tetanus, in eight of which recovery has taken place; and one of which was decidedly acute in its character.

Pathology.—There is abundant evidence that tetanus depends upon some lesion of the spinal cord; but of the precise nature of that lesion we have no certain knowledge. Increased vascularity, serous effusions, proliferation of tissue, and granular degeneration of cell structure have been noticed by different observers; but Billroth declares that his examinations of the spine and nerves in tetanus have hitherto furnished only negative results. Recently most pathologists have attributed the peculiar phenomena attendant upon the malady to a disturbance especially of the gray matter of the cord, the organ of generation of nerve-force; in evidence of which we are referred to the great exaltation of the reflex excitability which exists in these cases.

Treatment.—The local treatment consists in the removal, as far as possible, of the local irritation, in case any such irritation is found to exist. If the wound is suppurating, the matter must be allowed free exit; and all ichorous discharges should be corrected by antiseptics, or by the free use of warm water. Gangrenous sloughs should be treated, with reference to their causes, upon the general principles already discussed. All foreign bodies presumed to be sources of irritation must be carefully sought for and removed, whether they be fragments of dead bone, bullets, pieces of cloth, or anything else. Sharp and projecting points of bone must be exsected. Nor do I hesitate to say that, in case the disease has made but little progress, especially if only the muscles of the jaw are involved in the spasms, amputation will often afford a reasonable ground for hope; particularly when the amputation does not involve parts near the body, as where the wounds are situated in the fingers or toes, or even in cases of injuries of the forearm or lower portions of the leg. I am informed that in a case of trismus presented in one of the U. S. hospitals at Washington, prompt amputation of the forearm completely arrested the disease. Many similar examples have from time to time been reported by surgeons.

When tetanus supervenes upon the closure of the wound, and a nerve is supposed to be involved in the cicatrix, Larrey has recommended cauterization, or free incisions upon the cicatrix, or section of the nerve at some point above. This latter operation, namely, section of the nerve, may also with propriety be practised where the wound is still open.

In relation to the general treatment, great difference of opinion continues to exist. Among the remedies proposed and which have been actually employed are cathartics, especially calomel, castor-oil, and turpentine; colchicum; camphor, tobacco, with nearly all of the various anti-spasmodics and sedatives; cannabis Indica; alkalies; opium, in some of its forms; aconite; Calabar bean; ice; chloral; woorara; tonics; stimulants; chloroform and ether; nutritious diet; the application of the moxa, and of other counter-irritants to the spine. All of which agents have been said to effect cures, and at one time or another have been held in popular favor.

In my opinion, but few of these remedies are entitled to any special confidence; by far the largest mass of testimony having accumulated in favor of nutritious food, tonics, stimulants, and opiates; the latter of which, if employed at all, must be given in the most liberal and persevering manner; in some cases both by the mouth and by the rectum, or by the hypodermic method.

Chloroform has been tried very largely during the past few years, and so far as we can learn, almost universally by our army surgeons, but not with a success which would warrant its continuance —or, to say the least, its substitution for opium or morphine. It has been repeatedly stated by those who have made use of it,—and I have in two instances myself been able to confirm the observation, —that it generally controls in some measure the spasms; but not always does it accomplish even this, while it appears in most cases to cut short the disease only by causing a more speedy termination in death.

It would seem, indeed, that whatever general remedy we employ, we cannot hope for recovery except by sustaining the system until the local irritation—which we assume to be the *immediate* cause of the spasms in a large proportion of cases—has been subdued. The local effects of chloroform seem to be too transient to accomplish this end, while its general effects are too exhaustive to the vital forces to render its long-continued use in full doses compatible with life. In short, it is likely in itself to kill the patient before the disease can be extinguished; or, we might say, before the nervous lesion—whether it be a local irritation, or inflammation, or whether it be a consequence of general blood-poisoning—has had time to cease.

We might occasionally resort to chloroform in moderate quantities for the purpose of controlling measurably those violent paroxysms which the opium had wholly failed to affect; and it may be with propriety given freely in all cases where death seemed inevitable, for the purpose of removing the pangs of dissolution; but with the evidence as it now stands before us, we could not resort to it as the most reliable means of saving life.

Shock.—I shall in another part of this work, in connection with "concussion of the brain," refer again to this subject, and for this reason my remarks will here be limited to a few points which cannot be appropriately discussed in that connection.

The term "shock," as generally employed by surgeons, may be defined as a general paresis of the nervous system induced by external violence. The traumatism or violence may have acted primarily upon the great nerve centres, the brain or spinal marrow, or upon any portion of the peripheral nerves. It may be caused, therefore, by a concussion or any other sudden injury or commotion of the brain or of the spinal marrow; by injuries of the abdominal viscera, especially of the stomach, intestines, bladder or uterus, and more especially when these latter are the results of violence accompanied with contusion, such as gunshot injuries; by injuries of the nerves of the extremities, as in crushing accidents, or accidents accompanied by extensive laceration; by major amputations; by prolonged surgical operations of any kind, and in various other ways.

It is only to those examples of nervous depression resulting from traumatisms that surgeons have generally applied the term shock, but similar conditions of general nervous depression or even of complete and fatal paralysis may be caused by sudden and violent mental emotions, such as fright or pleasure, or by sun-stroke. Some writers have also sought to make of concussion and shock two distinct pathological conditions, while in fact concussion only stands in the relation of a cause to the condition of general paresis or collapse which we term shock.

Precisely how these agents or influences operate in producing shock is not known, but the symptoms which imply its existence have long been recognized. In its lesser degree the person affected is only dazed. He may be able to move his limbs and walk about, and perform many acts, such as to render assistance to others, and find his way home unaided. He may even say to those about him, and may actually think, that he is not injured, but he will be subsequently unable to recall the events immediately succeeding the accident; his condition resembling that of a person partially intoxicated.

In the more severe forms of shock, the patient loses temporarily the power of locomotion, he has a feeling of extreme exhaustion; he is pale and covered perhaps with a colliquative sweat; his urine may pass involuntarily; he may have nausea, imperfect vision and imperfect audition; his heart acts feebly, and his respiration is short or scarcely recognizable. In still graver cases, there is a total abolition of consciousness and of sensation, and death takes place speedily; preceded in most cases by cardiac embolism.

In either class of cases, if recovery takes place it is liable to be followed by a reaction, indicated by a general febrile disturbance, or by localized inflammatory actions. The tendency or susceptibility to serious reaction is much greater in some persons than in others, and cannot therefore be safely prognosticated. Sometimes it assumes the character of traumatic delirium; and with others the injury is gradually, and after indefinite periods of time, followed by chronic cerebral or spinal disturbance, with slow, but progressive paralysis of various portions of the body.

Since the introduction of railroads, some surgeons think a new form of shock has originated, which they designate the "railroad" shock, and describe as especially limited to injuries of the spinal marrow, and as peculiar to railroad collisions. They speak of them as characterized by the total or almost total absence of symptoms immediately after the receipt of the injury, and as resulting in the development of symptoms, such as localized pains and tenderness along the spine, of paralysis, loss of memory, etc., at remote and indefinite periods after the receipt of the injury. The reader will have no difficulty in classifying most of these cases under some one of the forms already described; but it is our opinion that a certain proportion, and perhaps the larger proportion, were not originally injuries of the spinal marrow at all. In some cases, no doubt, the spinal marrow or the central nerves have suffered directly and alone from the vibration; but in others the great and primary injury has been inflicted upon the ligaments of the spinal column, which may give no immediate indications of the lesions they have suffered, but subsequently take on an inflammatory action to be propagated eventually to the meninges and marrow at a later day. In this way alone can we explain the localized pain and tenderness found in most of these cases at different points of the spinal column. In this way alone also, if at all, we can admit and explain a difference between the injuries to the spine caused by railroad collisions and those caused by other traumatisms. In the one case, the rapid progression being suddenly arrested while the person is in the sitting posture, the upper part of the body is thrown violently forward, and then as suddenly arrested, in such a manner that the spinal ligaments suffer a severe wrench. The motions of the patient may be compared to the sudden arrest of the lash in the snapping of a whip.

The treatment of shock may be briefly summarized. It is to bring about reaction by rest, and in some cases by the aid of warm drinks and cordials, or by the application of heat externally, taking care at the same time not to push the reaction too far, bearing in mind that there is usually more danger in that direction than in the opposite.

Section of nerves has been occasionally practised for the relief of persistent neuralgia. In all cases probably it has been followed by temporary relief; but in most cases the pain returns after an interval of a few weeks, or months, indicating that the nerve communication has been in some way re-established; and recent experiments would seem to show that it is through the interposition of connective tissue in which ultitimately, according to Schwann, nerve cells are developed. In other cases, however, and in all cases in which **resection** of the divided nerve is practised, and the divided ends are not brought into contact, or in any way approximated, the same explanation cannot be offered for the return of the pain. I have repeatedly practised resection of a portion of the trunk of a nerve for obstinate neuralgia, and I am unable to record a case in which the pain has not ultimately returned, but usually after a longer interval than when only section has been practised. In these cases, it seems necessary to assume that other nerves have taken upon themselves the performance of the functions of the divided nerve.

In order to encourage the union of nerves which have been accidentally or unavoidably divided, some surgeons have advised and practised the employment of **sutures**. Very fine silver wire or animal sutures are recommended. If it shall be found sufficient, only the sheath of the nerve is to be included in the suture; but in case this is not sufficient, the operator is not to hesitate to include a portion of the nerve structure. A number of successful cases have been reported, but there is a very suspicious absence of reported failures, or of cases in which the presence of the suture has caused pain, tetanus, etc., results which are so well known to follow in many cases where only the small filament of a nerve has been included in a ligature.

Stretching of Nerves.—In 1872, Nussbaum first practised the exposure and stretching of nerves for neuralgic affections. Agnew, in his treatise on surgery, has given a careful enumeration of the reported cases of this operation as prepared for him by Dr. Harte: the enumeration covering a period of ten years. The total number is 350, and includes operations for sciatica, traumatic neuralgia, traumatic tetanus, neuralgia of the fifth pair of nerves, mimic spasms, miscellaneous neuralgic affections, locomotor ataxia, sclerosis of the cord, paralysis agitans, torticollis, paralysis, epilepsy, disease of the optic nerve, contracture, and spasm.

This enumeration ought to remove the reproach sometimes cast upon medical men, that they are slow to adopt new methods and new modes of treatment, and thus obstruct the progress of medical science. This method seems to have been tried in almost every pathological condition of the nervous system, including those in which no line of rational argument could lead to the inference that it might possibly prove useful.

Of the 350 cases recorded, 143 are reported as cured, and 151 improved; but Dr. Agnew, after a rigid analysis, admits only 47 cures and 33 permanent improvements, many of the cases not having been under observation a sufficient length of time to determine the question of permanency. He thinks it probable, however, that a considerable number of the rejected cases may have been permanent cures. As in all other cases where conclusions are to be drawn from statistics gathered from various and often irresponsible sources, no little allowance must be made for incorrect reports; nor can we omit to take into account the still larger number of cases in which surgeons, having operated and failed, or having met with some serious mishap, have found no occasion to report their cases. Dr. Agnew, in his conclusions, does not refer to the danger of causing paralysis, although the fact of its occurrence is occasionally mentioned. One patient died of septicæmia, and several other deaths seem to have been caused or hastened by the operation. It has happened that in the only two cases which have come to my personal knowledge, after stretching the sciatic nerve, considerable permanent paralysis of more or less of the muscles of the leg has followed, one of which cases has led to prosecution for malpractice. In reference to the period of time which ought to elapse after the operation before the permanency of the cure can be determined, if it be a case of neuralgia, I would say not less than six months. After resection practised by myself, there has once been complete relief for one year, and then the pain has returned with as much severity as before. Unfortunately for the value of Dr. Agnew's tables, he has not given us the period of time after which he would pronounce the relief permanent.

Limiting the application of the operation to examples of neuralgia, idiopathic or traumatic, it is my opinion that it is entitled to quite as much consideration as section or resection, in all those cases in which only nerves of sensation are concerned. It would seem scarcely necessary to say that, from this class of accepted cases, all must be excluded which are plainly of central origin. In cases of sciatica, and in other cases where large and compound nerves are involved, the danger of producing permanent paralysis of the muscles ought to cause the surgeon to hesitate until all ordinary remedial measures have been tried, and then only can the operation be justifiable when the pain is excessive and has continued for a long time.

There are many other examples of reflex disturbances, painful, spasmodic, or inflammatory, which, being peripheral in their source, may probably be subjected to a farther trial by this method; but the present experience does not promise much in that direction.

The operation consists in exposing carefully the nerve, separating it from the adjacent tissues, and, in the case of the large trunks, lifting it by the fingers, or in case of the small trunks, by a blunt tenaculum. As to the amount of force to be applied, the surgeon must exercise his own judgment. In some cases reported, the nerves have been torn, an accident which it is reasonable to suppose might occasion very serious results. In other cases, it is reported that force enough has been applied to the sciatic nerve to lift the leg without harm to the patient. I do not feel certain that harm did not come to these patients; but, at all events, it seems apparent to me that the application of this amount of force is neither judicious nor safe.

Coccydynia (syn.: coccygodynia, coccyodynia, coccygalgia, coccyalgia), described by Dr. Nott, of Mobile, in 1844, and subsequently made the subject of special study in its connection with uterine diseases by by Prof. Simpson, of Edinburgh, may be defined in its broadest sense as a painful affection pertaining to the coccyx.

A fracture of the coccyx has been followed by persistent pain in this region, and in some cases by necrosis. In other cases, coccydynia has ensued upon labor, in which examples the pain has been due to the violent strain inflicted upon the sacro-coccygeal articulation and the subsequent development of a chronic arthritis; or a chronic arthritis may be developed in this articulation by other causes, both constitutional and local. There may exist an idiopathic neuralgic condition of the nerves in the vicinity of the coccyx; or finally, coccydynia may be due to reflex disturbances arising from diseased conditions of the uterus, vagina, rectum, or bladder.

When we consider how liable the coccyx is to be moved in various directions, in parturition, in defecation, in rising or sitting down, it is not surprising that, a morbid sensibility in these parts being thus once established, it should, especially in a certain class of neuralgic patients, be easily perpetuated.

In case of necrosis, the separation of the dead bone may sometimes be expedited by surgical interference. When the sacro-coccygeal articulation is the primary seat of the trouble, it may demand absolute rest in the horizontal posture or excision of the articulation. If the source of the pain is properly referable to disease of the adjacent organs, the remedies are to be directed to these organs rather than to the coccyx. If it be idiopathic, that is to say, if it be due to a neuralgic diathesis, the remedies must be mainly general or constitutional. In any case in which it may be impracticable to reach and remove the cause, or where all ordinary remedies have failed and the suffering is great, the surgeon will be justified in making the operation first proposed by Prof. Simpson, namely, making on either side of the coccyx subcutaneous section of all the muscles and tendons which are attached to this bone. The relief sometimes, but not uniformly, given to the patient by this operation is, no doubt, mainly due to an arrest of those spasmodic muscular contractions which are present in most cases. The parts are in this way placed comparatively at rest.

CHAPTER XIV.

LESIONS OF THE VASCULAR SYSTEM.

Section 1.—Lesions of Arteries.

Temporary Means of arresting Arterial Hæmorrhage.

The instrument most in use as a temporary means of controlling hæmorrhage during the performance of amputations, and other operations upon the extremities involving large arteries, is the *tourniquet* of J. L. Petit. It is composed of two brass plates, with bars and rollers for the support of the strap, a screw furnished with a handle to separate the plates, and a strong strap and buckle. In applying this instrument, the plates are brought into apposition, a square pad, made of a roller three inches wide and two yards long, folded longitudinally, is laid over the artery and underneath the frame of the instrument, and the buckle being then made fast, the frames are separated by the action of the screw.

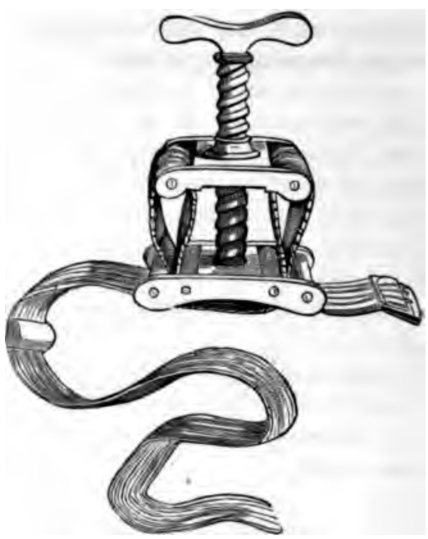
Many substitutes have been devised for Petit's tourniquet, but none of them possess in the same degree the qualities of simplicity and efficiency.

The *garrot* and *field tourniquet* can only be regarded as imperfect substitutes, to be employed in cases where Petit's tourniquet cannot be obtained.

The *garrot* is simply a cord passed around the limb, and tightened by twisting it with a stick thrust beneath the cord.

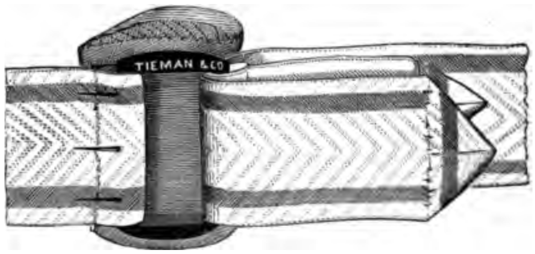
The *field tourniquet* is composed of a strap, buckle, and pad; and is essentially the same as the strap of a Petit's tourniquet, without its frame and screw.

Fig. 35.



J. L. Petit's Tourniquet.

Fig. 36.



Field Tourniquet.

Various instruments have been devised for the purpose of making direct pressure upon the main trunk of an artery, while they do not compress and ligate the entire circumference of the limb, such, for example, as Gross's artery compressor, Mott's field tourniquet, and others. While it may not be denied that in a few rare and exceptional cases these instruments will be found to serve a useful purpose, and especially when applied to the abdominal aorta, or when employed for the purpose of making permanent pressure, as in the treatment of aneurisms by compression, it must nevertheless be stated frankly that for all the ordinary purposes for which tourniquets are employed they possess no advantage whatever. Indeed, a moment's consideration will convince the surgeon that it is generally impossible to compress a large arterial trunk without at the same time compressing the principal veins through which the blood returns to the body; as, for example, when compression is applied to the femoral artery in Scarpa's space, it will be found impossible to avoid making pressure at the same moment upon the femoral vein; which latter is, with an equal amount of pressure, the more likely to have its circulation arrested, for the reason that its walls are more yielding. The same observation will apply to most of the large arteries supplying the extremities. But I would say further, that tourniquets which do not embrace the limb closely often thrust the artery aside by a certain amount of lateral or oblique pressure upon their walls; and that the instruments themselves, thus constructed, are very apt to become tilted or displaced in amputations, after the soft parts are divided. For these reasons they are not so trustworthy as Petit's tourniquet.

Hæmorrhage may be restrained temporarily, also, by pressure made with the fingers, or by flexing the index-finger and pressing with the second phalanx, or by the handle of a large key. I have employed in some cases two gimlets, tying the shafts together and wrapping both of the handles, now at opposite extremities, with cotton cloth.

Within a few years surgeons have employed for the same purpose, an elastic India-rubber bandage known as "Esmarch's," the bandage being made to embrace the entire limb firmly from its extremity to a point sufficiently high above the point to be operated upon, that the last turns, or the supplemental bandage, shall not interfere with the operator. In this manner not only the arterial blood is excluded from the limb, but the venous also; and in order to render this exclusion more complete, the limb is usually held up in a position as nearly vertical as possible for a short period before the bandage is applied and during its application. When the application is completed, a firm, supplemental bandage is applied above the first, and this latter is removed. In many cases the limb is now nearly bloodless, and the operator can proceed with an assurance that he will not be embarrassed by the presence of blood during the operation.

The advantages of this procedure in certain cases are apparent. Its disadvantages will therefore alone need to be mentioned.

Experience has shown that small vessels are apt to be overlooked, and that in this way secondary hæmorrhages are encouraged; that thin flaps are apt to slough subsequently, and that occasionally paralysis of the limb has resulted. The judgment of discreet surgeons is, therefore, that it ought to be employed with much care in all cases of amputation, and that in some cases it should be rejected, and that it is a resource more often available in resections and in other operations upon the continuity of the limb.

I have omitted to say that in case any portion of the limb is suffering from gangrene, or if pus, or any form of septic material is present in the tissues, it is quite possible that it may be mechanically displaced toward the body, or even forced directly into the circulation.

Spontaneous Arrest of Hæmorrhage; and Means Employed for its Permanent Arrest.

The means employed for the permanent arrest of arterial hæmorrhage are the ligature, acupressure, torsion, crushing, cold water and ice, hot water, the actual cautery, the potential cautery, the persulphate of iron, and various other styptics.

Before, however, considering the relative value of these several methods it will be proper to determine in what manner arterial hæmorrhage ceases spontaneously. When an artery is completely divided, and its walls, to the extent of an inch or more, are drawn out and exposed, the blood immediately escapes in jets—*per saltum*—in correspondence with the contractions of the left ventricle; at first in a full stream, but if the vessel is small the stream gradually diminishes in size, and in a few minutes it ceases altogether. If now the finger be passed along the course of the divided and exposed vessel, to a point varying from one-quarter of an inch to an inch or more from the point of its division, the artery will be felt distinctly expanding and contracting under the action of the heart, while below this point the vessel will be observed to be smaller, harder, and without distinct pulsation.

The vessel is in this case closed by the spontaneous formation of an internal clot; and the manner in which this clot has formed is sufficiently apparent. In consequence of the wound which the vessel has received, and partly in consequence of its exposure to the air, to the sponge, and to cold water, all of which act as irritants; but chiefly by virtue of its elasticity, the middle or muscular coat contracts and becomes involuted, or turned in upon itself, narrowing or completely closing the tube, and giving to its extremity a slightly conical form, the apex of which cone is at the divided end of the artery, and its base at a point half an inch or more removed. The muscular coat has in this case not only contracted in the direction of its circular fibres, but also in the direction of its longitudinal fibres; shortening the muscular tube and carrying with it the inner or serous coat, but not to the same extent the outer or cellular coat, or "sheath," as it is usually termed, which consequently is slightly drawn and folded in over the cut extremity, leaving a line or two of its inner filamentous surface exposed, prepared for the entanglement of the fibrinous elements of the blood. These circumstances are in themselves alone sufficient, in many cases, to insure the formation of a clot within the mouth of the vessel, and extending upwards at least as far as the first divergent branch. The formation of this clot is, however, often accelerated by any of those causes which abate the action of the heart, such as the loss of blood, the shock of the injury or of the operation, or the paralyzing influence of an anæsthetic.

In case, however, the artery is divided by a clean section, close to the surface of the surrounding tissues, and its trunk is not afterwards drawn out or exposed; and especially if, as usually happens, the divided end is retracted and becomes buried a few lines in the mass of the surrounding tissues; in such a case as this now supposed, the first and temporary closure of the artery does not depend solely upon vital contraction of its walls, involution, and the formation of an internal clot, but in a very large degree it depends upon the mechanical pressure of a second clot formed outside of the vessel, which has been called the external clot.

Arteries closed by an internal clot only, such as are often seen hanging exposed upon the surface of lacerated wounds, are liable to open again from displacement of the clot, and for this reason they demand often the ligature; but when arteries have retracted and become buried in such a manner as to afford an opportunity for the formation of the external clot, which clot, owing to its position outside of the force of the current, is less liable to displacement, the chance of a re-establishment of the hæmorrhage is much lessened.

If, when the hæmorrhage from a wounded surface is beginning to abate, a sponge is roughly drawn across the surface, the bleeding will be renewed from a certain proportion of the smaller vessels; and this will happen because the sponge has entangled and displaced the external clots, which cover in not only the sides but the ends of the divided vessels, and lie therefore very much exposed to the action of the sponge. It is possible that in displacing the external clot the internal will be withdrawn also.

From this observation it is inferred that if we desire the bleeding to cease, the surface of the wound must be left undisturbed; but experience will furnish a good many exceptions to this rule. If, for example, a small artery is divided and retracts only a short distance in somewhat loose areolar tissue, the blood escapes freely into the meshes of the adjacent tissue, forming a large external clot, like a thrombus, but which, since it lies in unresisting structures, makes no pressure upon the walls of the artery, and has no power to arrest the bleeding; but unfortunately this thrombus or external clot presents not only a negative influence, in that it serves no useful purpose, but it actually exerts a positive and mischievous influence, by preventing the contraction of the vessel, and the formation of the internal clot. This it accomplishes by retaining around the wounded vessel a soft and gentle covering, of the temperature of the blood, which effectually excludes the air and allows the vessel to return soon to its normal condition of dilatation, such as existed before it had suffered injury. If now the clot be forcibly detached and the vessel be again irritated by exposure to the air, and by drawing the sponge roughly across it, the bleeding may again cease, in consequence of a renewal of the contraction of the vessel, and by the formation of the internal clot; by leaving it exposed a sufficient length of time the occlusion may become permanent.

A further inference to be drawn from this observation is, that small vessels, lying in loose areolar tissue, such as is found in the neck, the axilla, the scrotum, and many other parts of the body, ought to be secured at once by the ligature; and that to insure their closure, the wound should be kept open until reaction has taken place, when, if they do not bleed, even though no external clot has formed, we can feel assured that they are effectually closed by the internal clot and by contraction of their coats.

The permanent closure and final complete obliteration of these vessels is effected by their continued contraction, by the effusion of fibrin within and around the vessels, by the degeneration and absorption of certain portions of the blood-clots, by adhesion of the inner walls of the vessels and at length by the conversion of all their coats into simple cords of connective tissue. Even these latter may in the course of time wholly disappear.

When an artery is divided in the midst of the tissues in such a manner that its continuity only is broken, and both the proximal and distal ends are exposed, the closure of both extremities is effected in the same way; only that it has been observed that the clots formed within and without the distal extremity are not so complete as at the proximal extremity, and that for this reason the former is most liable to reopen and give rise to a secondary hæmorrhage. If it is deemed necessary, therefore, to apply a ligature to the proximal extremity, it will be even more necessary to secure thoroughly the distal extremity; a fact which surgeons have not always fully appreciated, or if they have fully understood its importance, they have more often omitted to perform their duty in this regard, because the blood is not always at first seen to flow from the distal extremity, and the open mouth is not so easily found.

When an artery is partially divided, as in the case of many punctured wounds, spontaneous closure is not so easily effected, because the retraction and involution of the inner coats, upon which the formation of the inner clot mainly depends, cannot take place. In these cases the artery, if small, may be divided completely, when, perhaps, the bleeding will cease spontaneously.

Lacerated and contused wounds of arteries bleed less freely than incised wounds. In general, however, it is better to apply the ligature in these cases, since they are liable to slough, and thus give rise to secondary hæmorrhage.

In another part of this treatise I have spoken of the manner in which bleeding was made to cease after the infliction of wounds; namely, spontaneously, by the application of cold or of hot water, by the use of styptics and caustics, by exposure to the air, by elevation of the limb, by pressure, by the removal of obstructions to the free return of blood through the veins, etc. The ligature, however, has for a long time, indeed ever since its revival by Paré, been regarded as the most valuable resource whenever we have to deal with arteries of any magnitude. Its claims to superiority have nevertheless been from time to time disputed; and there are now, as there always have been, a few surgeons who claim for other methods special and general advantages. The remaining methods which of late claimed consideration are, torsion, acupressure, and crushing.

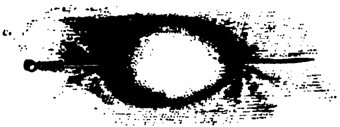
A complete statement of the grounds upon which the inventors and advocates of these several plans attempt to establish their respective claims for confidence, cannot be made in this place; but it will be sufficient to say that each method is designed to remove from the wound a foreign substance, and a continued source of irritation, such as they find in the ligature, and especially in the ordinary silk ligature; and which, they affirm, prevents union by first intention, and increases the danger of secondary hæmorrhage.

There is no difficulty in convincing the observing surgeon that the silk ligature does in some measure stand in the way of primary adhesion, nor that it is occasionally the direct cause of a secondary hæmorrhage; and the world will be benefited when a method of securing the vessels can be found which avoids these special dangers and incurs no others, or which has on the whole been proven to be more trustworthy than the ligature; but notwithstanding a very considerable aggregation of facts of experience, and a commendable zeal in pressing these facts before the public, we think we may say that practical surgeons have not generally relinquished the ligature in favor of either of these methods; nor do they seem at present likely to do so. Most of those who have commended the substitutes have plainly exaggerated the responsibility of the ligature in reference to secondary hæmorrhage; indeed it is certain that for a large proportion of these accidents the ligature is in no way responsible. Moreover, as regards my own experience, I can say that I have tied arteries of the second and third magnitude many hundreds of times, perhaps a thousand, and I cannot recall one instance in which the patient, being under my own care and observation, has died of secondary bleeding. To make this experience more pertinent, I will add that I have tied the primitive carotid fourteen times, and more or less often I have applied the ligature in continuity to every large artery in the body except the innominata, the aorta, and the internal iliac; secondary hæmorrhage has occurred but once in all these cases, and in this case the patient is still living and well. To disturb our confidence in the ligature, the advocates of other methods must present to us therefore a much larger and more varied experience than they have yet done. Theoretically, I should expect accidents from bleeding more frequently after torsion, acupressure, and crushing, than after ligation; and from all that I have seen and heard of these methods as practised by other surgeons, I believe that the accidents have actually been much more frequent.

As to the obstacles which ligatures oppose to primary union, it must be remembered also that there are other local and constitutional conditions which tend to defeat this end besides a ligature; and that there are a good many cases in which primary union is not desirable and is not sought for.

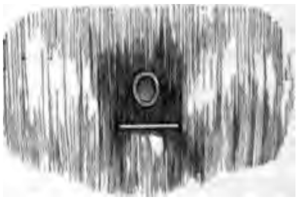
Acupressure.—In December, 1859, Sir James Y. Simpson first described to the Royal Society of Edinburgh, "*Acupressure, as a new hæmostatic process.*" His method may be briefly described as follows: —A needle is thrust through the flaps or sides of the wound, and after being made to cross and compress the mouth of the bleeding vessel, is again brought to the surface through the integument at an oppos point, "just in the same way that in fastening a flower to the lapel our coat, we cross and compress the stalk of it with the pin."

Fig. 37



Cutaneous Surface of Flap.

Fig. 38.



Wounded Surface of Flap.

Eight modifications of Simpson's original method have been formally described, but inasmuch as by almost common consent they have been all abandoned, or at least I think they ought to be, I shall not be expected to describe them.

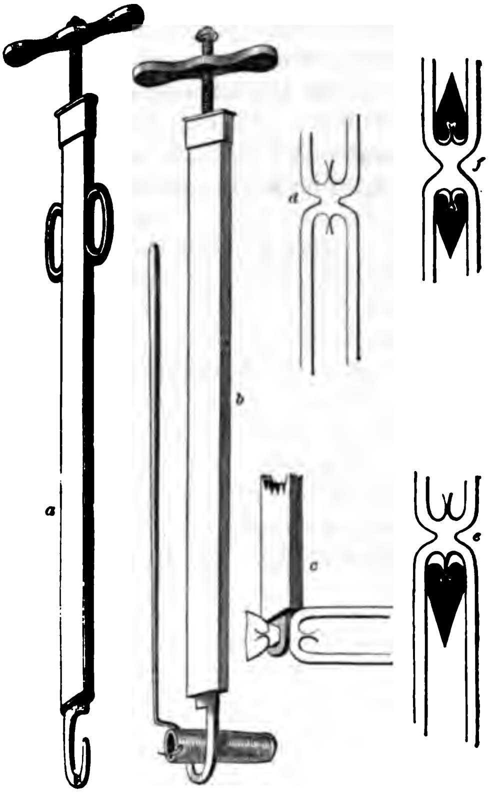
Torsion, as a means of arresting hæmorrhage, was first practised upon the human subject by Velpeau, in 1828. Subsequently, Amussat called more especial attention to its supposed advantages. After a brief period of favor it gradually fell into disrepute and was almost wholly abandoned, except perhaps as applied to very small vessels. So late as 1865, or 1870 perhaps, the practice has been revived, and in 1872 it was announced that at Guy's Hospital no other method has been employed during the last two or three years.

Amussat gives the following instructions for making torsion. The artery should be seized with forceps, and brought out several lines from the bleeding surface; and, having separated it carefully from the veins and nerves, and having forced back the blood which it contains, it should be grasped by another forceps near its root and held, while by gentle movements of the first forceps the internal and middle coats are torn; then, with the last-named forceps, the end of the artery must be twisted six to ten times with a rapid motion; and finally the internal coats must be pushed back within the cellular coat.

In addition to what has already been said of this as one of the hæmostatic measures by which it is attempted to avoid the presence of a foreign body in the wound, I will add that my own experience does not warrant me in recommending the practice except in the case of small vessels. Recently an English writer of no little reputation, and who had written in very eulogistic terms upon torsion as a hæmostatic, declared that he had abandoned this method, having seen two deaths caused by it. This statement was not made, however, until he had become a convert to, and a zealous advocate for acupressure.

Crushing, or "constriction," as it is termed by its inventor, Dr. Spier, was first brought to the notice of the profession in 1871, in a communication to the New York State Medical Society.

Fig. 39.



Spier's Artery Constrictor.

Fig. *a*. Constrictor. Fig. *b*. Mode of taking up an artery. Fig. *c*. First effect upon artery. Fig. *d*. Artery freed from instrument. Fig. *e*. Internal coagulum upon the invaginated internal and middle coats, in section of an artery. Fig. *f*. Same in continuity.

The "artery constrictor" consists of a flattened metal tube of about six inches in length, enclosing a steel tongue, which being thrust out, can be retracted within the tube by the action of a screw.

The hook of the tongue is so shaped as to form only a compressing, and not a cutting surface, and when the screw is applied the internal and middle coats give way, while the external coat remains unbroken. Immediately the two internal coats retract and become involuted; the involution being increased by the continued pressure of the tongue after the division is effected.

The application of the constrictor is as follows: The artery is to be seized by a pair of forceps, and the tongue of the constrictor placed around the vessel; the tongue is then drawn tightly upon the artery by means of the vice at the upper end of the instrument. As soon as the screw turns with a considerable degree of resistance, or the internal and middle coats are seen to be invaginated, by noticing their movements in the end of the artery, the instrument is to be detached from the artery and the operation is completed.

In the case of large arteries the tongue of the constrictor must be drawn into the sheath further than is necessary in the case of small arteries. When the instrument is applied, therefore, to large vessels the invagination of the internal and middle coats ought to be made complete by drawing the artery into the tube as far as needed to effect the object. "By a continued traction upon the external coat of an artery, after the invagination is once commenced, the internal and middle coats may be peeled up and pushed entirely out of the external coat, and this latter coat be drawn out through the sheath, entirely freed from its inner coat, so that the operator has it in his power to produce an invagination to any desired extent.

"It is well always to permit the blood to flow into the artery (if it has been controlled by tourniquet or otherwise during the operation) before removing the constrictor; this secures a perfect clot upon the invaginated coats, which can hardly be displaced afterwards.

"For convenience' sake, the constrictor may be made with three sizes of tongues, to be used with one tube so as to be useful in any sized artery."

It will be proper here to return to the consideration of the *ligature* as a means for the permanent closure of vessels, and I have no hesitation in saying, that among all the materials yet employed, there is not one which possesses so many qualities of excellence as a compact, round, firm and well-waxed silk ligature, and which for most purposes for which it is employed, should be of the usual size of harness-maker's silk. The ligature is to be applied firmly to the bleeding artery; and while one end is cut close to the knot, the other is to be left hanging from the wound. The suggestion that we employ instead the animal ligature, which being subsequently absorbed, does not require that any portion of it shall traverse the wound to facilitate its removal, and that by adopting this method we facilitate primary union, is sound so far as its application to a certain number of the smaller arteries is concerned, but it is not equally as reliable as the silk ligature in the case of the larger arteries, and there are many cases in which the presence of one or more silk ligatures reaching from the deeper parts of the wound to the surface is desirable as a means of drainage.

Traumatic Aneurisms. Syn.—Aneurysma ex vulnere, (R. C.)

Those tumors known as "traumatic aneurisms," differ so essentially from true aneurisms in their origin and in the rules which govern their treatment, as to warrant their separate classification. They constitute, according to the definition which I shall hereafter give of true aneurisms, one form of false aneurisms. There are two varieties of this accident; namely, the circumscribed and the diffused.

Circumscribed Traumatic Aneurism is usually the result of a punctured wound, the orifice through which the blood is permitted to escape being very small; in consequence of which the extravasation occurs slowly, and the blood partially coagulates as it escapes. The presence of the blood in the areolar tissue usually excites a moderate inflammatory action, and a wall of effused lymph limits the diffusion. The wall or cyst thus formed soon becomes lined with layers of fibrin, deposited from the blood which circulates through it in a sluggish current.

These tumors in most cases grow slowly, and in a few rare examples a spontaneous cure is effected by the pressure of the blood upon the wounded vessel, or by fibrinous solidification of the contents of the sac. They are recognized by their history, situation, pulsation, and bruit. In form they are usually round or oval; they are firm but slightly elastic under pressure.

When occurring in the smaller vessels, and before they have attained much size, well-regulated and constant pressure, made directly upon the tumor, will sometimes succeed in accomplishing a cure; but unless the anatomical relations render such a procedure difficult or impossible, a better plan is to at once expose the tumor, lay open the sac freely, and tie both ends of the wounded vessel.

When larger trunks are involved direct pressure seldom succeeds; but pressure, made above and somewhat remote from the aneurismal tumor, is a resource generally deserving a trial. In case, however, this should fail, as according to my experience it will in a majority of cases, we must proceed at once to lay open the sac, and tie the artery upon both sides. Repeated unsuccessful experiments have fully shown that the Hunterian operation does not usually succeed in these cases, and that there is no remaining reliable alternative but to tie the artery at the seat of lesion, and on both sides of the sac.

There is another form of circumscribed traumatic aneurism which is probably of less frequent occurrence; namely, that in which a small wound of an artery having closed, the cicatrix has subsequently yielded to the pressure of the blood, and an aneurismal sac has formed.

This form is usually recognized as one variety of false aneurism; but up to the period at which a rupture of the cicatricial sac takes place, it might, with equal propriety, be classed with true aneurisms. In these cases a considerable period of time usually elapses after the receipt of the wound, before the formation of the tumor; but in all other respects their history, progress, and symptoms correspond with the traumatic aneurisms first described.

The treatment of this variety is essentially the same as that already indicated as suitable in the first; only that direct pressure, which is a very doubtful resource in any case, is here scarcely worthy of a trial.

Diffused Traumatic Aneurisms have very little in common with true aneurisms, or with either of the forms of false aneurisms, and consequently their real character is often overlooked. They might, with equal propriety, be termed extravasations. The blood, escaping rapidly from a wound in an artery of considerable size, infiltrates widely and in every direction along the areolar tissue, causing the whole or a large portion of the limb to become enormously swollen, obstructing the venous, arterial, and nervous circulation. The swelling is due in these cases not alone to the extravasation of blood, but in part, also, to inflammatory effusions, and to effusions of serum, constituting œdema. The integument assumes a purple or mottled hue, and at the same time that the patient suffers intense pain in the affected member, it is preternaturally cold and its sensibility is diminished. Pulsation and the aneurismal bruit are often wholly absent, or they can be only feebly detected near the point of lesion. Their course is usually rapid, the general system suffering marked depression from the first, in consequence of the loss of blood from the circulation; and the limb soon becoming gangrenous from pressure.

Treatment.—But two alternatives are presented in diffused traumatic aneurism; namely, amputation or ligation of the artery at the seat of injury. In case the latter mode is chosen, the operator needs to possess, in an unusual degree, the qualities of skill, boldness, and decision. Every possible preparation must be made for contingencies. Just before commencing the incision a tourniquet ought to be applied to the main trunk leading to the point of lesion, provided it is found practicable to do so. The incisions must be long, bold, and rapid; with the hand the coagulated mass must be turned out, and as soon as the warm currents can be felt welling up from the depths of the wound, pressure must be made at these points by assistants, while the surgeon proceeds to clean and dry the cavity more thoroughly. He is fortunate now, if, before the patient has suffered great loss of blood, he is able to find and secure, first one, and then the opposite end of the bleeding vessel. In some cases the surgeon is obliged to search outside of the walls of the cavity containing the blood for the arterial trunks. By occasionally loosening the tourniquet the mouths of the vessels may be disclosed; and when the proximal end is tied, the tourniquet may be removed altogether, to enable the anastomosing vessels to receive the blood, and to encourage the circulation towards the distal end of the divided vessel. If possible, this end of the divided artery must be found and tied; or if this is impracticable, it must be either seared, or the wound must be so dressed that the interior can be constantly kept under observation until all danger of bleeding is past.

SECTION 2.—LESIONS OF ARTERIES AND VEINS CONJOINTLY.

Aneurismal Varix. Syn.—Varix aneurysmicus, (R. C.)

This is occasioned generally by a punctured wound, in which the instrument has penetrated at the same moment a vein and the contiguous artery, as happens now and then in bleeding at the bend of the elbow. The vein and artery being in exact apposition, and their opposing walls becoming adherent to each other, no blood escapes into the areolar tissue between the two vessels, but a portion of the arterial blood flows directly into the vein. The vein soon becomes dilated, tortuous, and its walls occasionally become thickened. Opposite the seat of lesion the vein suffers the principal dilatation, and the tumor assumes at this point an oval or fusiform shape. When superficial veins are implicated the tumor has a bluish color, and its pulsations can be distinctly seen. The pulsations of the artery are usually stronger upon the proximal than upon the distal side of the tumor. Firm pressure applied to the artery upon the proximal side causes the tumor to decrease in size. The pulsation of the tumor is accompanied with a slight vibration, and under the ear the sound is distinct, usually rough, but it varies considerably in different cases.

Upon dissection, in addition to the pathological changes already enumerated, the artery is usually found dilated above the point of lesion, and contracted below. The orifice of communication between the artery and vein is always smooth and rounded.

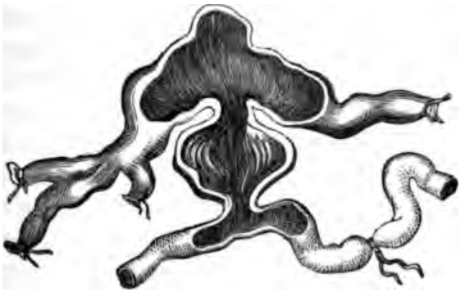
Treatment.—An aneurismal varix is not in most cases a very serious accident. Not unfrequently the veins, having suffered moderate dilatation, suffice to remove the arterial blood as rapidly as it is admitted; they undergo, therefore, no further expansion, and the patient experiences but little or no inconvenience. The only precaution required may be that the patient shall wear a slightly compressing elastic band, and that he shall make no extraordinary muscular efforts with the affected member. If, however, the varix steadily increases, there is no alternative but ligation of the artery above and below the seat of injury.

Varicose Aneurism. Syn.—Aneurysma arteriam inter venamque, (R. C.)

A varicose aneurism may be defined as a false or a traumatic, circumscribed aneurism associated with a varicose vein. It differs, therefore, from an aneurismal varix, in that a false aneurism is interposed between the artery and the vein, communicating with both.

The signs which denote the existence of this accident are in many respects the same as those which characterize an aneurismal varix; but in most cases the existence of two distinct tumors can be recognized, one superficial, fusiform, and discolored, evidently continuous with some one of the venous trunks, and emitting a vibratory sound; the other lying deeper, more distinctly circumscribed, the walls of which become more unyielding in proportion as the tumor increases in size, and which conveys to the ear a blowing or bellows sound.

Fig. 40.



Varicose Aneurism. Erichsen.

Treatment.—A varicose aneurism is seldom cured spontaneously. Owing, also, to the fact that the aneurism has a communication with both the vein and the artery, none of those methods of operation whose success depends upon a deposit of laminated fibrin within the sac can be relied upon. The artery must be ligated both above and below the point of lesion.

A doubt will sometimes remain as to the precise character of the lesion; but if the surgeon proceeds with caution, and in the proper manner, this uncertainty will soon be dispelled, and will cause no embarrassment.

A tourniquet, manual pressure, or Esmarch's bandage, being applied, a long and free incision must be made over the varix; the varix must be laid open with equal freedom, and while slight pressure is made upon the returning venous current below the varix, the cavity must be thoroughly emptied of blood and the orifice of communication with the aneurism sought for. Introducing a bent probe into the suspected orifice, it will be easily determined whether this is the orifice of a collateral vein, or the entrance to the aneurismal sac. If it is the latter the probe will move freely in all directions, and upon relieving the pressure upon the artery a jet of bright arterial blood will be thrown out. I must not forget, however, to remind the surgeon that when the patient is under the influence of an anæsthetic the color of the arterial blood differs but little, if at all, from the venous. Guided by a grooved director, this second chamber may now be opened upwards and downwards, and the communication with the artery sought for at its base.

If the aneurismal tumor is small, search may be made for the artery outside of the sac; but if it has attained considerable size its posterior walls must be penetrated on either side of the open orifice, and the ligatures then applied from the interior of the sac.

SECTION 3.—LESIONS OF VEINS.

Wounds of veins, like wounds of arteries, may be divided into simple incised, lacerated and contused, punctured, longitudinal and complete transverse. Their walls being much thinner than the walls of arteries, and their situation being for the most part more superficial and exposed, they are much more liable to rupture from contusion.

That the blood proceeds from a vein rather than from an artery may be easily determined when the wound is near the surface, by a knowledge of the anatomy of the parts, by actual inspection of the bleeding vessel, by the fact that the blood flows in a continuous stream and not *per saltum*, and by its darker color. When, however, the blood flows from a deep-seated vessel situated in the neighborhood of arteries of some magnitude, it is not always so easy to determine its source. The admixture of a certain amount of arterial blood, such as must inevitably flow from the track of a wound leading to a deeply-seated vein, may render it more bright colored; while on the other hand the blood issuing from a wounded artery may rise to the surface mingled with a considerable amount of venous blood. Various obstructions may prevent the escape of blood from an artery in jets corresponding to the pulsations of the heart; and finally, when the patient is fully under the influence of an anæsthetic, and especially if the anæsthesia has been continued a long time, the color of the blood is greatly changed, so that in many cases it can scarcely be distinguished by this test alone from venous blood. It must not be forgotten, also, that the blood flowing from the distal extremity of a completely divided artery is usually some shades darker than that which flows from the proximal extremity, and that it is often seen to flow in a continuous stream.

We are not permitted, therefore, in all cases to determine with certainty the source of the hæmorrhage; and it will be prudent often not to act hastily. In general the question may be easily decided, but in cases of doubt we may sometimes derive valuable aid from compressing on the cardiac side of the wound the main arterial trunk, from which the bleeding vessel is supposed to receive its supply. If the hæmorrhage is controlled, we know that we have to deal with a wound of an artery; but if it is increased, it becomes almost equally certain that a vein is the principal source of the hæmorrhage. In major amputations, especially since the introduction of anæsthetics, nothing is more common than the continuance of a free and somewhat alarming hæmorrhage after the main arteries have been tied, but which ceases immediately when the tourniquet is removed.

Veins, when completely divided, become closed by the contraction of their divided extremities and by the formation of clots, and eventually by cicatrization of the tissues, in a manner analogous to what we have described as occurring in arteries; but the contraction of the coats is very much less complete, and the manner of the formation of the clot is much less regular. Under favorable circumstances, however, their occlusion is much more easily effected, and their final cicatrization is equally if not more speedy than in the case of arteries. In the case of small vessels the closure occurs spontaneously in a very few seconds, or it may be hastened by elevation of the part from which the bleeding takes place, by applications of cold water, or by any of the various astringents; and finally, with only a few exceptions, the bleeding may be certainly and effectively arrested by moderate compression. In the exceptional cases to which we have referred, the ligature may be required. There is an impression among surgeons, which has long been entertained, that the closure of a wound in a vein by the ligature is more apt to be followed by phlebitis than when the closure is effected by other means. My own experience has furnished me with no proof of the correctness of this impression, although I have applied the ligature to veins in a great many cases. Nevertheless the opinion may be sound, and it will be proper to recommend the omission of the ligature whenever the bleeding can be controlled with equal certainty by other means.

A punctured wound, involving only one side of a large vein, may be closed successfully by a ligature applied around the wounded orifice, without including the entire circumference of the vessel. Thus, for example, it has happened recently that a patient was admitted into one of my wards at Bellevue Hospital, who, being insane, had cut his throat, dividing the larynx and œsophagus, and, as subsequently appeared, wounding slightly the internal jugular vein, but the wound had not penetrated the walls completely. On the following day, while the patient was in the act of vomiting, the vein gave way and blood was poured out rapidly, filling the trachea and threatening suffocation. Dr. W. G. Wylie, my house-surgeon, promptly removed the clots with a sponge, and having detected the orifice in the vessel, he was able to seize, first, one margin with a tenaculum, and then the other, and having everted both, he readily applied a ligature. The bleeding did not return, and when the patient died, two or three days later, from exhaustion consequent chiefly upon his refusal to take food, I found the ligature still in place, and the wound completely closed.

Entrance of Air into the Veins.—This accident has now happened a great number of times during the progress of surgical operations. The first recorded example was in the practice of M. Beauchesne, in 1818. The accident occurred during an operation for the removal of a tumor from the lower part of the neck, the patient expiring in less than fifteen minutes. Since then it is reported as having occurred in the practice of Mirault, Clemot, Roux, Majendie, Castara, Dupuytren, Delpech, Bégin, B. Cooper, Erichsen, Warren, V. Mott, and Stevens; and to these examples I am able to add my own case, recorded in the section of this volume devoted to the subject of "Enlarged lymphatic glands of the neck;" and also the case of death from the same cause in the practice of the late Professor Alden March, of Albany, N. Y. In this latter example, also, the accident occurred while removing a tumor from the neck, and when the operation was nearly completed. The patient died in a few moments. My own patient was saved. In the section of this volume just referred to, I have explained the manner in which the air, as it appeared to me, was permitted to enter the vein, when, in the last steps of the operation, the tumor, being attached to the outer wall of the vein, was lifted, thus separating the outer from the inner wall, and causing an opening which was plainly visible during the moment preceding the gush of blood.

The local signs which indicate the admission of air are a peculiar gurgling sound, in my own case resembling the sound produced by pouring water from a bottle. It is described by others as hissing, sucking, or gurgling; and bubbles of air have been seen escaping from the wound.

The constitutional effects are sudden prostration, an expression of alarm and of anxiety in the countenance, embarrassed respiration, violent and irregular action of the heart, followed speedily by great feebleness of action. Under the ear there may be observed also, sometimes, a churning noise synchronous with the ventricular systole, and "the hand applied to the chest perceives," says Gant, "a peculiar bubbling, thrilling, rasping sensation, produced by the air and blood being whipped together within the ventricle." When the quantity of air admitted is small, the patient may rally and recover; but if it is more considerable, death soon takes place during a convulsive struggle, or while in a condition resembling syncope. Some who have recovered from the immediate effects have subsequently died from pneumonia.

The immediate cause of death in these cases is supposed to be the presence of air in the pulmonary vessels, obstructing especially the capillaries, and thus arresting both pulmonary and systemic circulation. The heart's action generally continues for some time after respiration has ceased.

The conditions or circumstances which are thought to predispose to the admission of air into veins during an operation are the following: Incision of a large vein in the vicinity of the heart, and especially in the lower anterior portion of the neck, where these vessels experience a reflex pulsation. Canalization of a vein, in consequence of a thickening of its coats by morbid deposits, or in consequence of fibrinous infiltrations into the adjacent tissues, or owing to its being more or less embedded in a solid tumor; either of which circumstances convert the vessel into a rigid, uncollapsing tube. Attachment of the outer wall of the vein to the base of the tumor, so that in lifting the latter the two walls of the vein become drawn asunder, and collapse is prevented when the blood escapes. Traction made upon the outer wall of the vein by the forceps, or by tension of the overlying structures, or a deep inspiration made at the moment of dividing the vessel, may accomplish the same result.

In order to prevent the occurrence of this serious accident the surgeon should avoid, if possible, the wounding of large veins near the trunk, and especially in the neck or subclavian region; the parts should be kept as much relaxed as is consistent with the safe or convenient performance of the operation; when a tumor is lifted for the purpose of dividing its attachments at its base, the relations of important veins should be carefully studied before the incisions are made; finally, when dissecting in certain regions, whenever practicable, pressure should be made upon the cardiac side of the wound.

Varicose Veins.—Syn. Varices, (R. C.); Phlebectasis.

All portions of the venous system are liable to varicose enlargement, but varicosities occur much more frequently in certain veins than in others; as, for example, in the superficial veins of the lower extremities, especially in the vena saphena interna; in the left spermatic veins, constituting varicocele; and in the inferior hæmorrhoidal veins, constituting hæmorrhoids. Superficial veins are more often thus affected than deep-seated veins; of the latter, dilatations have been observed most frequently in the internal jugular, the vena azygos, and in the veins of the prostate gland. Occasionally venous dilatations are observed simultaneously in nearly all parts of the body.

Symptoms.—When the superficial veins of the lower extremities become varicose, the greatest dilatation is usually observed along the course of the internal saphena and in the neighborhood of the knee; the dilatation extending downwards with increasing ramifications, and terminating upon the top of the foot in a leash of vessels; in some cases the dilatation extends upwards also, along the thigh, and may be traced to the point where the saphena enters the crural canal. The condition of these vessels is more apparent when the patient is in the erect posture; and it will then be observed that the dilatation is exceedingly irregular, presenting at certain points knob-like projections, which are found to correspond, for the most part, to the situations of the valves; they are also usually elongated, in consequence of which they lie here and there in tortuous folds; to the finger they feel less compressible than veins in a normal condition, and in some cases they are quite hard, and perhaps tender to the touch, indicating coagulation of the contents, and the coexistence of a moderate phlebitis.

Patients with varices in their lower extremities experience often a sense of fulness or of weight while standing, and sometimes sensations of numbness or of actual pain. Eventually also, especially in the case of old people and anæmic women, the lower extremities become œdematous. But one of the most serious and, unfortunately, not infrequent results of varicose veins in the leg is the "varicose ulcer." At first the skin in the lower part of the limb, and generally near the ankle, assumes a leaden or coppery hue; slight vesications then occur, sometimes accompanied with eczema, and finally an ill-conditioned ulcer is formed, which is prone to extend, and is often exceedingly difficult to cure. In rare examples one of the veins is suddenly ruptured during some violent effort; an accident which may happen even before ulceration has taken place.

Causes.—The causes of varix in veins are general or predisposing, and local. The most constant predisposing cause is age, since this condition is almost never seen in infancy or childhood, rarely in early manhood, but very frequently in middle and advanced life. It is more common in women than in men. Habitual intemperance, inducing a general relaxation and feebleness of the system, and probably whatever tends to impoverish the blood and impair the tone of the system, are also equally predisposing causes. In some cases of general varix the condition of the heart, or of the whole circulatory and organic nervous systems, appears to be especially responsible.

The local causes are whatever obstructs or offers an impediment to the free return of the blood through the veins; as, for example, standing for a long time or excessive walking, wearing garters, the pressure of the gravid uterus, enlargements of the spleen and especially of the liver, abdominal tumors of any kind, fæcal accumulations in the rectum, and violent muscular exertions, which latter operate by compressing the veins and causing a sudden retrocession of their contents.

Pathological Conditions of the Veins.—The veins are sometimes simply dilated, or the dilatation may be accompanied by an actual hypertrophy or thickening of the walls, and especially of the outer or fibrous sheath. In most cases, however, the dilatation is accompanied with marked attenuation of all the coats; the transverse fibres of the middle coat become separated at certain points, and the internal membrane is permitted to press outwards, forming thus irregular projections upon the sides of the canal, and in some cases considerable pouches exceeding in size the diameter of the original vein; these pouch-like protrusions are found especially in the neighborhood of the valves. The inner coat presents after a time longitudinal striæ or fissures; the valves are attenuated, stretched asunder, and often rent, affording little or no support to the column of blood above. While these changes are in progress the veins increase in length in an equal proportion to their increase in diameter, so that they assume a tortuous course, and even become convoluted upon themselves. Occasionally the veins furnish evidence that they have been the seats of inflammatory action, and the blood, coagulated and mingled with fibrin, blocks up the channel completely.

Phleboliths, or small concretions of fibrin and other elements of the blood, are occasionally found in varicose veins. I have met with them several times in varices of the legs; and recently I have seen a case in which the presence of a "vein stone" caused so much inconvenience as to render its extirpation necessary. They seldom, however, attain a size larger than a pea, and they usually occasion very little or no inconvenience.

Treatment.—Varicose veins which do not occasion serious inconvenience, in whatever part of the body they may be situated, do not demand or justify operative interference. Veins are probably under all circumstances more liable to diffuse inflammation than arteries, but it would seem that when in a state of varicosity this predisposition is notably increased. The accidents resulting from attempts to obliterate veins are not, according to my experience, frequent, yet they are sufficiently common to admonish us not to make the attempt except where there is some urgent necessity.

In the case of varicose veins of the lower extremities, having as far as possible ascertained and removed the existing causes, we ought to give support to the vessels by a well-adjusted roller, or by an elastic or laced stocking. The latter, especially, will often afford to the patient great comfort.

The operations which have been suggested and practised for a radical cure of varices are numerous; but they have all one common purpose, namely the obliteration of the veins. Mr. Travers and others affirm that veins which have been ligated undergo repair without adhesive inflammation. It matters very little, however, whether this statement can be sustained or not, since the possibility of a diffuse phlebitis is established, and this result is equally liable to ensue whether the occlusion be effected by pressure made by means of metallic clamps, by cauterization, by incision, by ligation, by electrolysis, or by injection; but of all these methods, that most recently suggested, namely, the injection of solutions of the persulphate of iron, is most dangerous, since, in addition to the ordinary hazards of phlebitis, it adds the greater danger of admission of irritating fluids into the circulation, and of embolism. Already the operation has caused death by one or both of these latter accidents. It is probable, also, that injection is, of all the methods hitherto proposed, the least reliable for a permanent occlusion of the vessels.

There is an apparent necessity for a further remark before describing the surgical expedient to which I have hitherto in most cases resorted, namely, that all surgical operations for the relief of varicose veins in the extremities, as indeed in most other parts of the body, can be considered only as palliatives. They seldom or never, at least in the case of the lower extremities, effect a complete or radical cure. Whenever it becomes necessary to operate for varices of the legs, so large a number of the anastomosing vessels are involved, both superficial and deep-seated, that the obliteration of any more than a fraction of the whole is simply impossible, and certainly would not be attempted by any discreet surgeon. We only propose, therefore, to arrest the current of blood through a few of the largest and most troublesome vessels, so as to render the condition of the patient thenceforward more comfortable.

The mode of procedure which I have hitherto practised is as follows:—The patient standing erect so that the veins may become conspicuous, with a camel's-hair pencil moistened with the tincture of iodine, the situation of the largest is marked out, and these are generally those situated in the neighborhood of and below the knee. The patient is then placed in the horizontal position, a vein is lifted with the finger and thumb, and a pretty large needle is passed under it, carrying a strong silk thread. A pledget of lint is now laid upon the integument, over the vein, and the ligature is tied firmly over the pledget of lint, including of course the vein and integument. A second ligature is passed in a similar manner about one or two inches from the first, and tied in the same way. These ligatures are repeated, in most cases, from eight to ten times, including all of the most prominent vessels. A large poultice, made of flaxseed, is then applied over all the portions of the limb through which ligatures have been passed, and the patient is left in bed. By the fifth or sixth day the poultices are removed and the limb dressed with simple cerate, but the decubitus is continued. The ligatures are left a day or two longer, when they will be found to have made their way out through the vein and skin by ulceration, or if this has not happened, they can be cut and removed. It is not prudent even now to permit the patient to rise, nor for a few days later, since the occlusion of the veins is too recent to render it certain that they will not reopen. If the patient remains in bed three weeks, with the limb during the latter portion of this time inclosed in a roller applied moderately tight, a larger proportion of the vessels will be found to have become obliterated, and this to a greater extent than if these precautions are omitted; and even when he leaves the bed, the laced stocking or the bandage should be worn for some time after, and perhaps it may be necessary to continue their use during the remainder of active life.

Inflammation of the Veins. Syn.—Phlebitis, (R. C.)

Causes.—The usual local causes of phlebitis are contusions, lacerations, punctures, or incisions; in short, all injuries and lesions of veins are liable to be followed by inflammation of their coats, but in most cases the inflammation is limited to the neighborhood of the parts which have suffered injury, and is too insignificant to attract attention or to demand consideration. In other and exceptional cases the persistence of the source of irritation, the foulness of the wound or the presence of a constitutional dyscrasy, such perhaps as is usually present in cases of erysipelas, increases the activity of the inflammation and encourages its extension beyond the ordinary bounds.

Inflammation of the veins may occur as an *idiopathic* affection, independent of any lesion; as from exposure to cold, as sequelæ of fevers, or from various other causes affecting the general system. It has already been observed that a condition of varicosity of the veins sometimes induces inflammation of their coats. From whatever cause idiopathic phlebitis results, it is most frequently observed in the veins of the lower extremities. It is also in most cases self-limited in its character, and seldom entails serious consequences.

Varieties of Traumatic Inflammation of the Veins.—Traumatic inflammation of the veins has been divided into three varieties; namely, the adhesive, the suppurative, and the diffuse.

Adhesive Phlebitis.—Guthrie has denied the existence of adhesive phlebitis. There is much reason to suppose that adhesive inflammation of the inner coat of a vein is a rare event, but there is no satisfactory evidence that it never occurs. Adhesive inflammation of the two outer coats is however a frequent and well-recognized condition. When superficial veins are the seats of adhesive inflammation, they feel hard and knobby, the enlargements occurring chiefly in the situation of the valves; they are tender to the touch, and the overlying tegumentary coverings, having become involved in the inflammatory action, assume often a reddish or a reddish-purple color. When the superficial veins of the lower extremities are alone implicated, a moderate œdema, with a sense of weight, accompanied sometimes with a degree of numbness and occasional pains, constitute the remaining local phenomena. Some general febrile disturbance is also usually present, which sustains a pretty exact proportion to the degree and extent of the local symptoms.

In case of adhesive phlebitis occurring in deep-seated vessels, as for example in the larger pelvic or femoral veins, œdema of the limb becomes the most prominent, as it is usually the earliest local symptom; the œdema pervading all portions of the areolar structure, and causing great and universal enlargement of both the leg and thigh. The surface assumes a marble-white color and pits deeply under pressure.

Suppurative Phlebitis.—This term is employed to designate a condition which might properly be regarded as one stage or variety of adhesive phlebitis, in which the inflammation results in circumscribed suppuration; the canal of the vessel becoming closed on either side of a coagulated mass of blood, and a small abscess forming, in most cases in the neighborhood of some of the valves. Venous abscesses thus formed seldom break through the barriers of clot and adhesive material which nature has interposed, or empty themselves into the venous canals; but, like abscesses originating in other structures, they usually approach the surface of the integument, in which direction they open spontaneously, or they may be evacuated by the knife.

In some cases, however, the adhesive plug is disorganized or gives way in the direction of the current of blood, and that series of symptoms is then likely to ensue which we denominate **pyæmia**. The occurrence of this grave accident is usually announced by the sudden accession of rigors, by a feeble and rapid pulse, accompanied with nausea, prostration, copious sweats, and other symptoms of purulent infection. Whether the toxæmia is due to the admission of pus-globules, as such, into the general circulation, or to the admission of disintegrated or gangrenous fibrin, or of other elements of the decomposed blood, is not in the present connection a matter of practical importance; and we shall therefore omit its discussion, only remarking that the presence of pus in the blood is known to be a rare event, and that most recent writers upon this subject are disposed to deny its agency in the production of pyæmia.

Diffuse Phlebitis.—Diffuse phlebitis bears the same analogy to adhesive phlebitis that erysipelatous inflammation of other structures does to acute phlegmon. It occurs most often in persons suffering under cachexia, or whose constitutional vigor is in some way greatly impaired. It is characterized by the rapid extension of the inflammatory action along the course of the vessels, unaccompanied with coagulation of the blood, so that the veins seldom have the cord-like feel described as characteristic of the adhesive variety. The general symptoms are early announced, and are of a grave character; such as a feeble, fluttering pulse, a brown and dried tongue, total loss of appetite, nausea, diarrhœa, and delirium, indicating the lowest and most fatal form of ataxic fever.

Treatment.—In all the forms of acute phlebitis, absolute rest in the recumbent posture must be enjoined. Open and suppurating wounds must be kept clean, and treated with soothing poultices medicated with carbolic acid, or some of the well-known antiseptics. Unless the temperature of the parts affected is preternaturally lowered, or the general symptoms indicate great prostration, moderately cool, evaporating lotions should be applied constantly over the course of the affected vessels. In other cases warm fomentations may be preferred. In the acute and adhesive forms one or more brisk saline cathartics will generally prove useful; but in the suppurative form, when pyæmia is announced, and in diffuse phlebitis, stimulants, tonics, and nutrients can alone be relied upon to sustain the system during the period required for the elimination of the poison.

SECTION 4.—LESIONS OF THE LYMPHATIC SYSTEM.

Inflammation of the Lymphatics. Syn.—Lymphatitis; angeioleucitis.

Causes.—Lymphatitis occurs most often in persons of a strumous or lymphatic temperament; but, independently of any cognizable constitutional peculiarity, certain persons seem especially prone to inflammation of the lymphatics from slight provocations. A trifling injury inflicted upon the foot or toes may cause an inflammation which will be propagated along the course of the absorbents, and be indicated in the groin by a swelling of one or more of the lymphatic glands. The prick of a pin, or an abrasion of the skin upon the fingers, may give rise to inflammatory engorgements of the axillary glands. In a large number of the cases of serious or fatal lymphatitis, occasioned by wounds or other local injuries, which have come under my notice, the original lesions were of the most simple character; such as a wound in the integument of the knee made by a small carpet-tack, or the puncture of the finger by a pocket-knife. It seems probable that in these cases the imprisonment of a small amount of pus or of decomposed animal structure, and as a consequence a genuine septicæmia, ought to be regarded as responsible for the fatal results. But the most frequent examples of lymphatitis are from wounds which are known to convey a toxic influence, such as autopsy wounds, wounds inflicted by venomous insects, serpents, etc.

Symptoms.—Inflamed lymphatics, when superficial, present a reddish-purple color, not unlike that which indicates the course of an inflamed vein; but the color is generally more inclined to purple, the lines are narrower, more numerous, more tortuous, and anastomose more freely. Like inflamed veins, they may feel indurated and cord-like, but they are easily distinguished in that they are much smaller. The œdema is usually limited to the subcutaneous areolar tissue when the superficial lymphatics alone are involved. When deep-seated lymphatics are inflamed the whole limb may become enlarged and œdematous, as in cases of deep-seated inflammation of the veins; but whichever set of lymphatic vessels is implicated, a tegumentary erysipelatous blush is an earlier and more constant attendant than in cases of phlebitis, and the integument presents usually a more brawny feel.

Most cases of lymphatitis terminate in the course of a few days in resolution, leaving often a certain amount of induration of the lymphatics, with enlargement and induration of the adjacent lymphatic glands. In other examples the inflammation terminates in the suppuration of one or more glands; and in a majority of these cases it is either the superficial inguinal or the axillary which suppurate. More rarely suppuration takes place in the course of the lymphatics themselves in a manner analogous to what has been described as occurring in the veins, forming, in the case of the superficial vessels, small pustular elevations here and there in the course of these vessels, and in the case of the deeper vessels giving rise to larger and sometimes enormous collections of pus.

Finally, in the graver examples, the symptoms of pyrexia, which are nearly always present in some degree in all cases, assume a low adynamic character, with all the signs of pyæmic infection.

Treatment.—The constitutional treatment is generally in these cases of primary importance, and will be indicated by the condition of the system, the nature of the exciting cause, and the symptoms which may be present. When these latter assume an adynamic type the treatment can only be sustaining.

The local treatment consists in rest, the application of warm, soothing fomentations, the free incision and *débridement* of strangulated tissues, and the early evacuation of purulent or gangrenous collections. The importance of this latter indication cannot be too strongly impressed upon the mind of the surgeon; and inasmuch as the pus often forms very rapidly in the areolar tissue beneath the brawny skin, through which fluctuation cannot easily be detected, there should be instituted from an early period daily and careful examinations, in order that it may be removed as soon as it is formed. Unless this is done, extensive strangulation, with sphacelation of large portions of the limb, is likely to bring the case to a speedy and fatal termination.

Inflammation of the Lymphatic Glands. Syn. Adenitis.

Allusion has already been made, when speaking of inflammation of the lymphatic vessels, to the frequent occurrence of inflammation of lymphatic glands from slight injuries inflicted upon parts quite remote. In a certain proportion of these cases, there is reason to suppose that a morbid material has been conveyed directly to the glands without causing any inflammatory disturbance in the vessels through which it has been transmitted. This happens very commonly in case of the reception of syphilitic virus, and in many examples of poisons received from dissection wounds; but in a majority of examples in which the virus possesses considerable activity the lymphatic vessels are primarily affected, and the glands only become finally implicated by continuity of structure. In either case the virus, or *materies morbi*, is liable to be arrested and detained in the glands, causing thereby speedy engorgement, and provoking not unfrequently suppuration, which, when it occurs, often terminates the progress of the inflammatory action towards those blood-vessels into which the lymphatics finally debouch. These facts afford conclusive evidence that, whatever physiological purpose the lymphatic glands may subserve, they occupy a very important position in their relations to that large class of maladies whose existence is dependent upon the introduction of noxious materials into the blood. They constitute a series of outward defences against the approach of enemies toward the citadel. We have no cause for regret, therefore, when the contest is made in the glands and suppuration ensues, since in this manner we may hope that the virus will be thrust out. It need scarcely be said, however, that the suppuration of a lymphatic gland does not always arrest the progress of the poison. In the case of the reception of syphilitic virus into the lymphatic vessels, preceded or accompanied by a genuine chancre, suppuration of a gland occasionally ensues, without giving to the patient immunity against a constitutional infection; and in other cases of inflammation of these vessels due to traumatic or other causes, one gland after another yields to the suppurative action, and the general system derives no apparent benefit from the depuration. In some of these cases protection is not gained by the suppuration, because, although the gland may be the seat of a pretty active inflammation, the pus may have formed only in the connective tissue wholly outside of the lymphatic vessels which compose in part, if not altogether, the proper gland structure. In other cases the poison is too subtle or too virulent to be thus arrested; and in still other cases the engorgement and suppuration of the glands are only indications of the universal diffusion of the virus, the suppuration representing a retroactive influence.

Treatment.—Whenever the inflammation is due to some purely local cause, such as an unhealthy or foul sore, or a fragment of dead bone, or other foreign and irritating substance at the seat of primary lesion, attention must first of all be directed to the removal of these palpable sources of disturbance. Most often the inflamed gland is situated at some point in the extremities where flexion and extension are the most free, as for example in the groin or axilla, and the patient scarcely needs to be instructed as to the importance of rest in securing an abatement or retardation of the inflammatory action. As local applications, warm and emollient poultices, or dressings of simple cerate, are in most cases useful and appropriate.

While on the one hand the application of blisters, of the tincture of iodine, and of other external stimulants, or as they are generally designated "absorbents" and "discutients," has in many instances greatly aggravated the local inflammation, and in a manner so palpable as to leave no possible room for doubt; on the other hand I have never had any evidence worthy of acceptance that these agents have in a single instance dispersed these swellings. I would not think it worth while to call in question their efficacy, and especially the efficacy of the tincture of iodine, so much employed in these and all other varieties of tumefactions, when a placebo is required to amuse the patient until nature effects the cure, or until the diagnosis is better made out, except that their application to inflamed lymphatic glands is in most cases an act of cruelty which the supposed exigency does not justify.

Crushing and continued pressure as a means of removing acute glandular engorgements, more mischievous even than vesicants or discutients, have probably done less harm, inasmuch as they were received with more distrust, and have met with a more speedy judgment and condemnation.

When pus has formed it should be early evacuated in order to abridge the sufferings of the patient, and to prevent the infiltration of the pus into the adjacent areolar tissue.

The appropriate constitutional treatment consists mainly in the regulation of the diet, or in the exhibition of a single saline cathartic, except in so far as the affection depends upon a peculiar dyscrasy, or the presence of some peculiar poison in the blood. A consideration of these latter conditions is reserved for other portions of this treatise.

CHAPTER XV.

ANEURISM.

Syn.—Aneurysma, (R. C.) True Aneurism.

SECTION 1.—GENERAL CONSIDERATIONS

Surgical writers have not agreed in their classification and nomenclature of aneurisms. I shall adopt the method which I have been accustomed to follow in my teaching, as being that which appears to me most natural, and to possess the most clinical value.

A true aneurism is a blood-sac or tumor formed by an expansion of one or more of the coats of an artery, and which communicates with the interior of the artery. Hereafter the term "aneurism" will be employed exclusively to denote this condition.

Cirsoid aneurisms, so called, are not included under this definition. Although they, like aneurisms, are formed of expanded arterial tunics, they differ in so many points relating to their pathology, history, symptoms, and treatment, that it has been thought proper to treat of them under the head of "vascular tumors," and in especial connection with "aneurisms by anastomosis," to which latter they seem to bear the closest relationship.

An important practical division of aneurisms is into fusiform or tubular, and sacculated; to which some writers have added dissecting.

Causes.—Aneurism occurs most frequently between the ages of thirty and fifty years, less often in advanced life, and still less often in childhood and infancy. Males are more subject to aneurisms than females. Syphilitic, gouty, and rheumatic diatheses, with the habitual use of alcoholic stimulants, are also regarded as predisposing causes.

The remote predisposing causes above enumerated give rise to certain degenerations of the arterial tunics; which degenerations diminish the elasticity and contractility of the vessels, lessen their power of resistance to the impulse of the blood, and thus it happens that these latter become in their turn direct predisposing causes.

Atheroma is, in most cases, the primary pathological condition which terminates in arterial lesion. Its origin is not determined. It is believed, however, to be a deposit from arterial blood, or from blood actively oxygenated. At first it may be observed as slightly colored or buffy patches or striæ upon the inner coat of the artery, thin, soft, and shining. It is most often met with upon the inner surface of the arch of the aorta, and of the first diverging branches.

Successive layers of atheroma give additional thickness, breadth, and firmness to the deposit; its color deepens, and its attachment to the inner coat becomes more intimate. Up to this point it appears to be a vital process of re-enforcement. Then commence the processes of degeneration: the inner coat disappears in the atheroma; the middle and outer coats atrophy, and in some cases receive molecular deposits of fat-globules; fatty degeneration, commencing in the interior of the consolidated mass, extends toward the inner surface, a lesion is soon established, the impact of the blood washes away the detritus, and a sacculated aneurism is begun. In the case of a tubular aneurism the atheromatous deposits, and the consequent metamorphoses and degenerations of tissue, are less localized, so that a diffused expansion precedes the absolute lesion of the inner coats.

In exceptional cases, instead of the fatty degeneration of the atheroma, as above described, a cartilaginous or calcareous degeneration may ensue, or these several processes may be coincident.

It is quite probable, also, that the softening of the arterial tunics, which attends certain stages of arteritis, is one of the efficient causes of aneurisms following contusions, sprains, and some other local injuries.

Vidal observes that an artery may become aneurismal in consequence of its being deprived of the support of the adjacent tissues; as where, by abnormal distribution, it approaches too near the surface. In cases where a large number of aneurisms occur in the same individual, it is probable that the ganglionic system of nerves is in some way responsible.

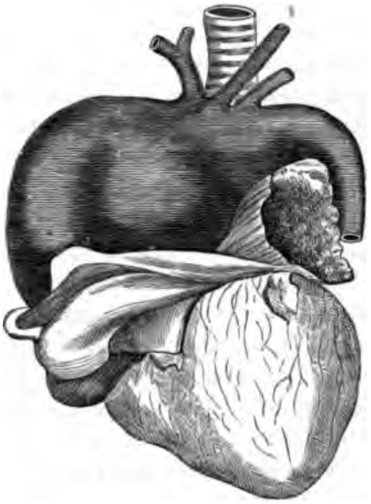
The most common exciting or immediate causes are contusions, strains, and violent muscular efforts.

The order of frequency of spontaneous aneurisms cannot be stated very absolutely; but the vessel which is most often the seat of aneurism is the aorta, especially the ascending portion; and after that the thoracic and abdominal portions. The popliteal artery is next most liable, then the femoral, the primitive carotid, the innominata, the subclavian, the axillary, and external iliac. They occur frequently at points of greatest flexure in the course of an artery, or where large branches are given off, indicating the effects of long-continued and violent impact of the arterial current.

Fusiform Aneurism. Syn.—Aneurysma Fusiforme, (R. C.) True Aneurism, of Broca, Holmes and others; Tubular; Cylindroid.

This form of aneurism occurs most frequently in the aorta; next in point of frequency it is met with in the iliac and femoral arteries. It is formed by a dilatation of all the coats of the artery; the coats also for a time increase in thickness, and the whole of the affected portion of the artery becomes elongated. In this latter respect it resembles the "cirsoid aneurism." Occasionally some portion of an originally fusiform aneurism gives way more or less completely, and a sacculated aneurism is superadded. While an aneurism retains its tubular form its progress is generally slow, and its existence is not incompatible with the continuance of life for many years; but when it assumes the sacculated form, by lesion of one or more of its coats, its progress is more rapid.

Fig. 41.



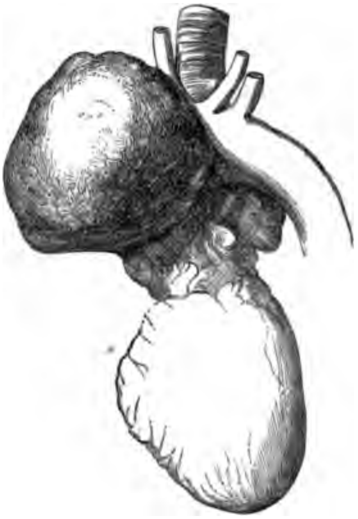
Fusiform aneurism of the ascending aorta, bursting into the pericardium. Erichsen.

Sacculated Aneurism. Syn.—Aneurysma Sacculatum, (R. C.)

The term "sacculated" is applied to aneurisms whose form is oval, round, or sac-like, and whose mouth or channel of communication with the artery is relatively small. It may originate directly from an artery, or it may spring from the walls of a fusiform aneurism, in the manner already described.

It is possible that an aneurism may be sacculated without a lesion of either the internal or middle coats of the artery; that is, like the fusiform aneurism, it may be formed by a dilatation of all the coats. This condition, however, can never obtain except in the case of small aneurisms, and even in these cases its occurrence must be regarded as altogether exceptional. In almost all cases one or both of the internal coats have given

Fig. 42.



Sacculated Aneurism. Erichsen.

way, and the sac is composed only of the external coat, with such adventitious coverings as a certain degree of inflammatory action may have provided.

Dissecting Aneurism. Syn.—Aneurysma Dissecans, (R. C.)

Up to the present time this accident has not been met with except in the aorta. The lesion which gives rise to the aneurism occurs most often near its origin; but it has been found as low as the bifurcation. A rupture of the internal coat takes place, allowing the blood to escape between the several coats, and the impulse of the heart now drives the blood forward, separating the tunics until at some point sufficient resistance is encountered to cause the internal coat again to give way, when the current resumes its natural channel. The length of the abnormal channel or diverticulum is sometimes not more than a few inches. I have seen it nine or ten inches in length, with several secondary openings. It has been known to extend to the axillary and popliteal arteries. Dr. Peacock observes that the separation always takes place between the layers of the middle coat, leaving a portion of the muscular coat external.

A short diverticulum may exist several years without giving rise to very urgent symptoms; indeed, it is probably seldom a cause of death, unless the artery bursts into the cavity of the pericardium, or into the areolar tissue.

Structure of Aneurisms.

The number and condition of the coats composing the walls of an aneurism will vary according as it belongs to one or another of t varieties described.

When the aneurism is composed of all the coats, the atheromatous patches will generally be found scattered over various portions of the inner wall; but when it is formed only of the outer coat, as happens in nearly all examples of sacculated aneurisms, no such appearance of the walls can be observed.

It must be seen, also, that fusiform aneurisms, lying directly in the current of the circulation, cannot detain the blood sufficiently to cause a separation and deposit of fibrin. Sacculated aneurisms, on the other hand, situated in some sense outside of the direct current, receive and detain the blood; as a result of which, and perhaps in consequence of the agitation which it undergoes in the cyst, the fibrin becomes deposited in concentric layers; so that while the aneurism is enlarging in its circumference, its capacity for receiving blood may be stationary, or it may actually diminish; a fact which suggests the method in which a spontaneous cure has sometimes been effected, and which explains the gradual loss of pulsation in the aneurismal tumor in the progress of its growth. These fibrinous layers are observed to be whiter, tougher and more distinctly lamellated near the circumference of the sac. As we approach the centre the lamellæ are more loose and more discolored, and finally can scarcely be distinguished from the blood-clots which, in post-mortem specimens, usually occupy the central portion of the cavity.

The central lamellæ are usually stratified in such a manner as to indicate the direction of the current of blood through the sac. No such appearance, however, can be seen in the outer and more decolorized layers; and it has been thought that these latter ought to be regarded as plastic effusions from the coats of the aneurismal sac, and not as fibrinous deposits from the blood. Hence, Broca terms the outer fibrinous lamellæ "active" clot, in contradistinction to the more central and softer clot, which is termed "passive." The latter is probably, most often but not always, a post-mortem formation.

Symptoms and Diagnosis of Aneurisms.

In the case of external aneurisms, or of those which pertain to the extremities, the symptoms are usually such as lead to prompt recognition. It will be proper, always, to ascertain whether there is any dyscrasy in the system predisposing to the fatty degenerations, and to examine other portions of the body for atheroma or calcification of arteries. The history, also, may indicate the period and manner of its origin.

The special local signs are those of a tumor situated in the course of an artery and inseparable from it. The form of the tumor, except in cases of fusiform aneurism, is oval or globular, and well defined. It is slightly compressible and elastic. By continual and pretty firm pressure, made directly upon the tumor, its size may be sensibly diminished. The size may also be diminished somewhat by elevation of the limb, or by pressure made upon the artery above the aneurism.

The most pathognomonic signs of an aneurism are, however, pulsation and bruit. The pulsation differs essentially from that caused by a solid tumor resting upon an artery. In the case of the solid tumor it is lifting, or in the direction of a line drawn from the centre of the artery to the centre of the most salient point of the tumor; while in the case of an aneurism it is expansive, eccentric, or centrifugal, being felt with almost equal force upon all points of the circumference of the tumor. It will be noticed, also, that in the case of a tumor situated over a large artery, the strength of the pulsation is usually increased in proportion to the growth of the tumor, while for reasons already given the reverse is generally true of aneurisms.

The bruit or murmur accompanies the pulsation, and is caused by the friction of the blood upon the margins of the opening or the mouth of the sac, and upon the coagulated or fibrinated contents, and by the ricochetting and tumult of the blood after contact with the walls of the sac. Like pulsation, it is generally more distinct in recent than in old aneurisms. It is also sometimes rendered more distinct by elevation of the limb, when the sac is partially emptied. In the case of large aneurisms we frequently observe the bruit most plainly when we place the ear or the stethoscope upon the course of the artery near where it enters or emerges from underneath the tumor. The bruit is generally louder and more rasping in fusiform than in sacculated aneurisms.

The symptoms which characterize a dissecting aneurism are seldom sufficient to enable the surgeon to form a diagnosis during life.

Most of the cases have occurred in advanced life, and were associated with disease of the heart; and in a few examples the occurrence of the primary rent has been announced by a sudden pain, by a diminution of pulsation in the branches of the artery affected; by coldness, and partial loss of sensation and of motion. In some cases, also, there has been observed characteristic murmurs.

Other symptoms pertain to aneurism, according as it is situated in one or another portion of the body, and according to its size and complications; but these are in most cases due alone to pressure, or to encroachments upon other organs, and are common to all forms of morbid growths. One of the most interesting of these special signs is the loss of voice, or the hoarseness and spasmodic respirations caused by the pressure of a thoracic aneurism upon the recurrent laryngeal nerve, and which has, in some cases which have come under my notice, furnished the earliest reasons for suspecting the existence of an aneurism. In a case of aneurism of the innominata recently presented in one of my wards at Bellevue, death was plainly due to a spasm of the rima glottidis caused in this manner.

Spontaneous Cure of Aneurisms.

A spontaneous cure of an aneurism is an infrequent event. I cannot say that such a case ever came under my notice, but numerous well-attested examples are recorded.

The spontaneous cure may be brought about in several ways. The pressure of the aneurismal tumor itself may obstruct the entering or emerging arterial current; a fibrinous clot may become detached and block the artery as it emerges from the aneurism; the aneurism may inflame, suppurate, and perhaps slough before it has attained sufficient size to cause death when its rupture takes place; but by neither of these processes is the spontaneous cure most commonly effected. The usual method has already been intimated when considering the formation and structure of an aneurism. The cure is effected in most cases by the gradual deposit of concentric layers of fibrinated "active" clot. Nearly all sacculated aneurisms exhibit a tendency to a spontaneous cure by this method, but unfortunately all the conditions requisite for the uniform and steady deposit of the active clot over all points of the circumference of the sac, and for its maintenance after the deposit has taken place, are so seldom present that a spontaneous cure by even this method rarely occurs, and can seldom be anticipated or hoped for.

Treatment of Aneurism in general.

The treatment of aneurism may be either general or local. Formerly, all thoracic and abdominal aneurisms were regarded as wholly beyond the reach of local treatment; but during the last half century such has been the progress of surgery that even aneurisms of the ascending and descending aorta have been successfully treated by strictly surgical means. It is true, nevertheless, that in a large proportion of visceral aneurisms general treatment constitutes the only available and, perhaps, the most reliable resource. In most external aneurisms, also, general therapeutics properly applied may contribute eventually to the successful result of the local measures.

General Treatment.—It will facilitate our understanding of the process of cure by constitutional means, and greatly simplify our formulas of treatment, if we premise the statement that our purpose is to imitate as nearly as possible the process by which a spontaneous cure is most often effected; namely, to encourage the formation and maintenance of an active fibrinous clot. To this end we seek to diminish the force of the heart, to place the aneurismal sac at rest in a position best suited for the prevention of arterial engorgement and centrifugal pressure, and to modify the condition of the blood so as to increase its capacity and disposition to deposit fibrin.

First in point of importance is absolute rest in the horizontal posture. The value of this means cannot be over-estimated. It is probable that in very many cases of reported cures by internal medication, bleeding, etc., where absolute rest was also enforced, the fortunate result was, in fact, mainly due to the latter.

Bleeding and low diet constitute the essential elements in the treatment known as Valsalva's, which at one time had secured for itself an unequalled reputation. As often happens, the disciples of this method have never been able to accomplish as much as did their master; a fact which will admit of two explanations: either the disciples possess less faith and observe less rigidly the rules and conditions of success, or the works, including the failures, of the master have not received a faithful record.

Valsalva, by repeated small bleedings and a descending scale of diet, brought his patients down gradually to a condition of such extreme anæmia that they were scarcely able to raise their arms in bed; a process well calculated to abate the force of the heart, and at the same time to actually diminish the amount of blood-corpuscles and of albu men, while the amount of fibrin in the circulation might not be sensibly diminished. The relative proportion of the latter being therefore increased, the coagulability of the blood might be increased in the same ratio. Experiments, however, do not show that these results are uniform, and it is far from being established that we can by this method regulate with any degree of certainty the amount of fibrin in the blood or insure its increased coagulability.

Digitalis, veratrum, and aconite are sufficiently capable of controlling the action of the heart to suggest their employment as agents in the cure of aneurisms; but they are all too capricious and unmanageable to permit their employment in adequate doses and for a sufficient length of time. Notwithstanding a considerable amount of testimony in favor of these agents, it must be admitted that they are at the same time less efficient and more hazardous than the method of Valsalva.

Gallic and tannic acids, ergotine, and the acetate of lead, have been employed in obedience to certain chemical and physiological theories, but they have hitherto failed to secure for themselves such a reputation as would entitle them to a further trial.

A number of cases of thoracic and abdominal aneurisms have been reported as cured, and others as having been sensibly diminished in size by the use of the iodide of potassium in doses varying from fifteen to thirty grains daily, and continued several weeks or months. Balfour, of Edinburgh reports fifteen cases treated by this method, in twelve of which there was a sensible abatement of the size of the tumor, and several were cured. M. Bouillaud has had a similar experience, having, by the use of this agent, in one case, effected a cure of a carotid aneurism. In the hands of most surgeons, however, who have resorted to this method it has proved unsuccessful, and of late it has fallen very much into disuse.

Local Treatment.—*The Ligature.* In the use of the ligature for the cure of aneurism several modes have been practised, which may be described as follows: first, ligation of the artery close above and below the sac; second, ligation near the sac but only on its cardiac side; third, ligation near the sac, and only on the distal side; fourth, ligation of the artery on the cardiac side, but remote from the sac.

Each of these several methods possess certain advantages which authorize their occasional adoption; but in a large majority of cases of true aneurism only the last of the four is at the present time employed.

Ligation of the Artery close above and below the Sac—Method of Antyllus.—This was the method of operating practised by Ætius, Paul of Ægina, Guy de Chauliac, and by most of the older surgeons. It was variously modified by different surgeons, and especially by Antyllus, by whose name the method is usually called. The operation of Antyllus was as follows: Pressure being made upon the artery above the aneurism, to control as far as possible its circulation, the tumor was then incised freely, the clots turned out, and ligatures applied both above and below the aneurism; subsequently, when the ligatures had completely separated, the aneurismal tumor itself, or whatever of it might remain, was dissected out.

No one at the present time considers it necessary to remove the sac, but in other respects surgeons occasionally repeat to-day the operation of Antyllus. It is almost the only operation practised in cases of traumatic aneurisms, as has already been shown; but for several reasons it is considered inapplicable to true aneurisms, and to all varieties of spontaneous aneurisms.

The extensive suppuration which inevitably ensued when this operation was practised, in the case of large spontaneous aneurisms, often proved fatal; gangrene of the limb was a frequent result, partly in consequence of the intense inflammation which was apt to follow, and, perhaps not unfrequently, in consequence of the inclusion of important veins and nerves in the ligature, which could not easily be avoided; and finally, the most vital objection to the operation as applied to spontaneous aneurisms was, that the atheromatous or otherwise diseased condition of the arteries in the vicinity of the aneurism rendered a secondary hæmorrhage almost inevitable.

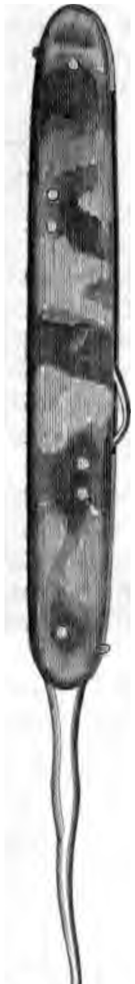
In the case of spontaneous aneurism, however, occurring in the gluteal region, it is still considered by many surgeons quite as safe to attempt the application of the ligature in the wound as to search for the internal iliac. Mr. Syme has also within a few years employed this method in several examples of spontaneous axillary aneurism, with brilliant success.

Ligation near the Sac but only on its Cardiac Side. Method of Anel.—Having occasion to treat an aneurism in a missionary of the Levant, Anel applied, on the 30th of January, 1710, a ligature to the brachial artery, immediately above the tumor and without touching the sac. Velpeau has claimed for this operation that it was essentially the same as that subsequently introduced by Hunter; but, as we shall hereafter see, Hunter applied his ligature remote from the aneurism, while Anel tied the artery indeed without the sac, but yet so near as to expose the patient greatly to the hazards of a secondary hæmorrhage. It is now well understood also that the ensuing pathological changes upon which the two operations rely for success are essentially different.

Ligation near the Sac and only on the Distal Side. Method of Brasdor.—Brasdor was the first to formally propose the application of the ligature in certain cases at some point below the aneurism; but Deschamps was the first to carry it into execution.

Briefly, it may be stated that the operation is seldom successful; yet there are few surgeons of the present day, who have had a large experience in the treatment of aneurisms, who have not seen cases in which this operation presented the only surgical alternative, at least so far as the ligature is concerned; and I have myself seen at least two examples, one of which occurred in my own practice, in which Brasdor's operation has accomplished a complete cure. The limit of its application, however, is to those cases in which, owing to the situation of the aneurism, the ligature cannot be applied according to the Hunterian method. In the case of very large aneurisms it is questionable also whether the application of the ligature upon the distal side will not sometimes endanger a rupture of the aneurismal sac.

Fig. 43.



The Author's Aneurism-Needle. Full Size.

Ligature upon the Cardiac Side and remote from the Sac. Method of Hunter.—Hunter made his first operation according to the method which now bears his name, in December, 1785. The point of distinction between the operation made by Anel, seventy-six years before, and that now for the first time made by Hunter, was simply that in the one case the ligature was applied near, and in the other case it was applied more or less remote from the aneurism. By this apparently insignificant change in the mode of procedure, Hunter introduced a new plan of treatment, the principle upon which its success depends being essentially different from that of any other mode of which mention has yet been made. By the method of Anel, for example, it is the intention of the ligature to suspend entirely the current of blood through the aneurismal sac, and thus to cause the formation of a clot. By the Hunterian method, the ligature being applied remote from the aneurism, the intermediate collateral circulation at once establishes a feeble current below the ligature, and the circulation through the aneurismal sac is not suspended, but only retarded; a passive clot is not formed, or, to say the least, it is formed in less amount than by Anel's operation, while the sluggish current allows and encourages the rapid deposit of fibrin, and the consequent formation of what is termed the active or fibrinous clot. It is in fact an imitation of the process by which Nature accomplishes a cure, and can more properly be compared to the modern method of cure by moderate compression made at some point on the cardiac side of the aneurism, than to Anel's method, which Velpeau, Broca, and other French writers claim to be identical with that of the great English surgeon.

General Instructions for Ligation in Aneurisms, according to the Hunterian Method.

The instruments required for the ligation of arteries in continuity will differ according to the point selected for the operation, the depth of the incision, and other circumstances.

In most cases a knife, a pair of artery forceps, a couple of retractors, and an ordinary aneurism-needle, armed with a strong thread of silk, are all that is required. The aneurism-needle which I have used in nearly all my operations is the same which is found in my pocket-case, and which is intended also to serve the purpose of a strabismus hook. The shaft is firmly fixed in the handle, and the distal extremity has a rather abrupt and short curve. The large curve given to the extremity of most aneurism-needles rather obstructs than facilitates their passage beneath the artery, except in the case of very large arteries. I have found no difficulty, however, when using my own instrument, in applying the ligature to the subclavian artery and to the external iliac. A movable extremity is only required in the case of arteries very deeply situated.

American surgeons generally use the aneurism-needle invented by Drs. Parrish, Hartshorne, and Hewson, of Philadelphia, and still further modified by Dr. Mott, and which is known as the "American aneurism-needle."

Fig. 44.

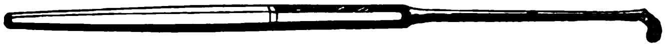
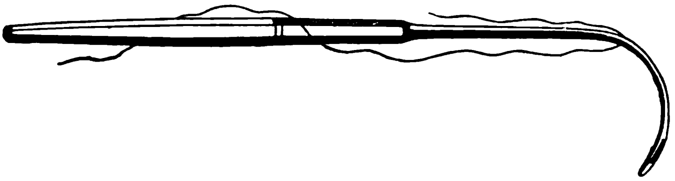


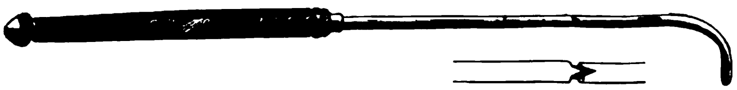
Fig. 45.



American Aneurism-Needle.

Having sometimes experienced difficulty in the use of the American aneurism-needle on account of the liability of its extremity to become loosened and turned in the wound, a medical student, Mr. S. W. Fletcher, now Dr. Fletcher, of Massachusetts, at his own instance, had constructed for me an instrument illustrated by the accompanying woodcut, and which, borrowing the suggestion from M. Seutin, I shall call the movable immovable aneurism-needle.

Fig. 46.



Movable Immovable Aneurism-Needle.

The instrument may be constructed of any size and form, to suit the taste of the operator. Like the American needle, it is composed of two sections: the lower or curved section being furnished with two eyes, one for the reception of the ligature, and the other for the reception of the hook employed for the purpose of steadying the lower section, while the upper end, or shaft, is being unscrewed, and for the purpose of withdrawing the lower section, with the ligature attached. The shaft is perforated and receives a steel rod, furnished with a button-head for the convenience of turning it. The lower end of the steel rod terminates in a male screw, and is destined to work in a female screw in the upper end of the lower section. The upper section, or shaft, is provided at its lower end with two triangular teeth, and the upper end of the lower section with two corresponding triangular depressions.

The two portions being adjusted to each other, the screw is projected, and with one or two turns effectually locked. After the point of the needle has been passed beneath the artery, and while it is held by the hook, a couple of reversed turns of the screw again disengages the extremity.

The ligature preferred by myself, and I think by most other surgeons, in this operation is a strong silk thread, of the size generally used by harness makers.

The following simple rules of procedure given by Dr. Valentine Mott, after an almost unequalled experience in the treatment of aneurisms by the ligature, comprise nearly all that needs to be said. My own not very limited experience confirms the value of the principles he attempted with so much clearness and emphasis to teach.

"We would advise all who tie large arteries to bear in mind, that after the edge of the muscle is laid bare, which is the anatomical guide or landmark for the relative situations of the artery, *very little use should be made of the knife.*

"With his fingers, or the handle of the scalpel, the surgeon can readily separate the parts so as to fully expose the artery. In this way he will be much less troubled with the oozing of blood, from cutting the small vessels, and thereby better enabled to see the principal trunk more distinctly.

"With the parts held asunder with curved spatulas, the surgeon now seizes the filamentous structure with the forceps, and raises it from the artery. He then cautiously divides the structure *perpendicularly, and upon the anterior surface of the artery only, and should never dissect or use the edge of the knife on the sides of the artery, but introduce the handle of the knife, and separate the structures from the artery on each side, only denuding the vessel to an extent sufficient to allow the hook to be passed around it.*

"This rule we believe to be most important, as by using the edge of the knife on the sides of the artery we endanger frequently the division of branches, as most of them are given off laterally; and the flow of blood when they are divided, obscures and interferes very much with the beauty and neatness of the operation.

"Denuding the artery, also, to any considerable extent, of its filamentous structure must, by robbing the vessel of its connecting media, always be adverse to the salutary changes which we expect from the ligature."[1]

When introducing the ligature, the point of the hook must always be carried between the artery and the accompanying vein, so as to avoid the inclusion of the latter. One ligature is sufficient ; and as a rule it is advisable to apply this near the upper angle of the wound made in the sheath. Before tying the artery it should be lifted slightly with the loop of the ligature in order to make sure that nothing but the artery is included. The ligature must then be tied firmly upon the artery, and one end being cut away, the other must be left hanging from the wound. The wound is now to be closed by a few stitches, if necessary, or by short and narrow strips of adhesive plaster. The limb must be laid in an easy, horizontal position, surrounded with masses of cotton batting to encourage warmth and circulation. Under no circumstances ought a bandage or adhesive strip to be applied which will in any degree interfere with the free course of the blood through the limb.

For some time I have been in the habit of using instead of the handle of the knife or the fingers, as recommended by Mott, somewhat blunt instruments, made expressly for the purpose of displacing the tissues where it is inconvenient or unsafe to use the knife. The instruments, some of which are illustrated in the accompanying woodcuts, are supported by firm handles, and have various forms, but all are more or less flattened at the extremities, so that they may be easily

Fig. 47.

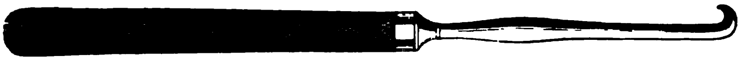


Fig. 48.

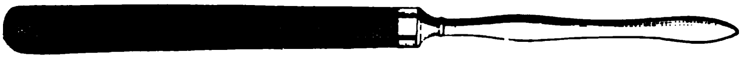
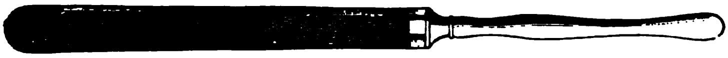
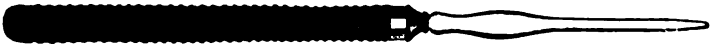


Fig. 49.



Front View.

Fig. 50.



Side View.

Instruments for Dry Dissection.

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[1] *Velpeau's Operative Surgery.* First Amer. Ed., with notes by Valentine Mott, M.D. Vol. 2, p. 301.

insinuated between the filaments of areolar or muscular tissues. The handle of a knife is not always of an appropriate form and size, and in using it the surgeon exposes his hand to be cut by the blade. The instruments which I have substituted may be appropriately termed instruments for dry dissection.

Treatment of Aneurisms by Instrumental Compression.

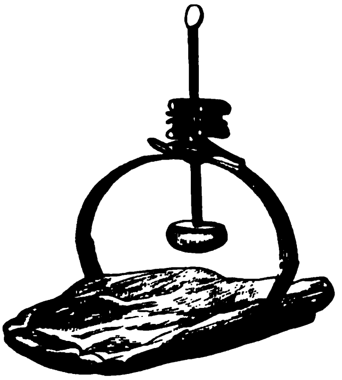
There has probably been no period of time, since surgery has been practised as an art, that pressure has not been applied, in one way or another, for the cure of aneurismal tumors. It is scarcely worth while, therefore, to attempt to trace the origin of the practice, or to notice the modifications which have been suggested by different operators. The methods now universally adopted are, as has already been stated, imitations of the process by which nature most often effects a cure. The Hunterian method of applying the ligature encourages the formation of the lamellated or active fibrinous clot, but it may and sometimes does happen that a soft or passive clot is formed instead; a result which endangers sloughing of the tumor, or which, to say the least, renders the cure less probable. We have seen that sloughing with secondary hæmorrhage are the chief sources of mortality in the operation practised first by Anel. By indirect graduated pressure, applied in the course of the artery supplying the aneurismal tumor, the force of which pressure is only sufficient to abate the circulation without arresting it entirely, the conditions most favorable for the deposit of fibrin in the sac, and for a permanent cure, are supposed to be attained. Indeed it is observed that in many cases *intermittent* pressure, applied at short intervals and for only a brief period, has proved sufficient to cause a moderate fibrinous deposit; and that, the process having been once begun, it has continued to the complete solidification of the tumor, without further surgical interference.

To the Dublin surgeons, Drs. Todd, Hutton, Tuffnel, Carte, and especially to Dr. Bellingham, we are indebted for this important addition to our surgical resources in the case of aneurisms, and for very much of our present knowledge of what constitutes the basis of success in this and in other methods of treatment. The discovery may be said to date from about the year 1842.

Most of the cases hitherto reported as treated by this method were aneurisms of the lower extremities, especially popliteal aneurisms. I shall therefore explain the mode of applying mechanical pressure in a case of aneurism of the lower extremities. The reader will find no difficulty in modifying the plan of procedure to suit other examples.

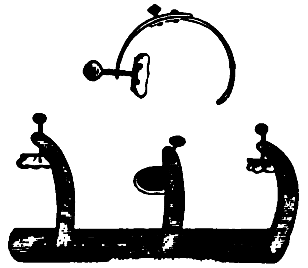
The "compressor" employed in these cases differs from the ordinary tourniquet in not being allowed to press upon the entire circumference of the limb; and in the construction or duplication of the pads and screws, so that the direction, point, and force of the pressure may be varied at discretion and easily. Carte employs an instrument in which elastic bands are substituted for screws. In some cases surgeons have preferred to employ two compressors at the same time, applied at different points in the course of the artery, in order that by their alternate relaxation and tightening the skin may be relieved from the effects of too long continued pressure. Dr. Gibbons, of Philadelphia, employed three, supported upon a wide, long concave steel plate, and which were rendered adjustable by fenestræ and screws.

Fig. 51.



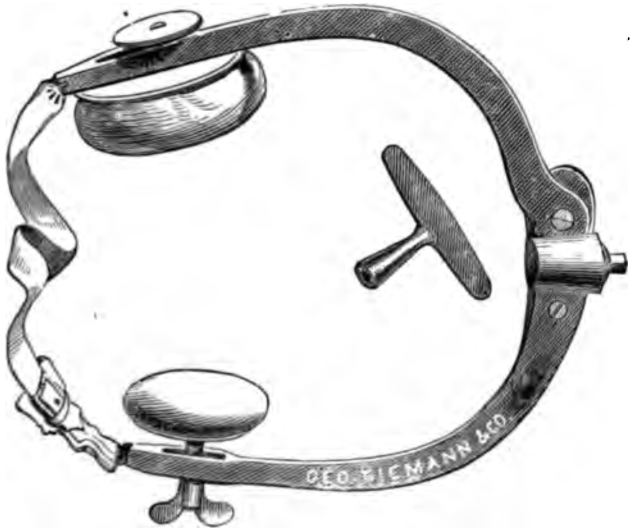
Carte's Compressor.

Fig. 52.



Gibbons' Compressor.

Fig. 53.



May's Compressor.

Before applying the instrument the hair should be shaven from those portions of the limb which are to be subjected to pressure, and the whole limb should be carefully bandaged from the toes upward. Where the bandage covers the aneurismal tumor a soft cotton or air pad should be interposed.

Pressure must be made in the direction of the bone; at first pretty firmly, in order to ascertain the amount required to cause complete arrest of the circulation; and then it must be gradually slackened until the circulation is partially re-established. As to the precise amount of pressure, much will depend upon the tolerance of the patient, and its effect upon the tumor and upon the limb. When it becomes quite painful, or the limb grows œdematous, it must be relaxed, or the point of pressure must be changed.

The period required for the accomplishment of a cure varies from a few hours or days to several weeks or months. The average period of treatment in 24 cases of popliteal aneurism, reported by Mr. Hutchinson as having been cured, was 19 days; one of these cases, however, was under treatment eight months. But in the 99 cases collected by Broca, the average period of successful treatment was only 15 days.

The ratio of success has varied considerably in the different statistical reports. In Ballingall's report of 25 cases, made in 1847, most of which were treated in Ireland, there was but one failure. No similar success has been recorded by any other surgeon. Of 46 cases of popliteal aneurism treated by pressure, reported by Mr. Hutchinson, 22 were failures; but in a later report, made by the same gentleman, there were only 14 failures in 39 cases.

It is believed by the more zealous advocates of this plan that the dangers incurred are less than by any other; that the cure, when wrought, will be on the average as speedy; and that inasmuch as it encourages collateral circulation, if the ligature has finally to be applied, there will be less danger of gangrene of the limb.

Possibly this may be all true as stated, but it does not yet appear to have been very conclusively proven. Mr. Syme was not convinced that compression, as a rule, possessed any advantages over the ligature; and my own experience convinces me that it is by no means so certain a remedy; and that it is in most cases a much more tedious and often a very painful process. Nor is it so free from danger as has sometimes been represented. One case is reported in the *Medical Times* for 1860, in which the pressure caused a speedy and fatal rupture of the sac; and other cases have come under my notice in which the life of the patient seemed to be endangered by the rapid increase of the tumor, and by the enormous swelling of the limb, ensuing upon the most carefully adjusted pressure.

Mr. Holmes thinks, and others have repeatedly affirmed the same, that pressure in almost all cases places the disease under more favorable conditions for cure, provided the ligature has finally to be applied. It would seem that, in so far as pressure tends to improve the collateral circulation, this statement ought to be true; but then it is apparent, from the congestion and œdema which so often accompany the treatment, that the limb is not always placed in the most favorable condition for the restoration of collateral circulation; and I have to relate that, in one instance at least, after a fair trial of compression during several weeks, a resort to the ligature caused gangrene of the limb, and finally the death of my patient. Moreover, the difficulty of making an operation, certainly a matter of some account, is always sensibly increased when one has to cut through tissues already infiltrated and swollen with inflammatory effusions, which are the inevitable results of pressure made for any considerable length of time.

The cases in which instrumental pressure especially merits a trial are: first, those in which there are present decided cardiac complications; second, those in which the simultaneous or consecutive occurrence of aneurisms in various parts of the body indicates general atheroma; third, all cases occurring in constitutions greatly enfeebled from any cause; and fourth, in those examples in which, for any reason, the ligature or other methods are inapplicable. It is especially adapted to the cure of aneurisms occurring in the popliteal space, or at any point of the limb below the middle of the thigh.

There can be no valid objection to a brief trial of this method in any other case which may be presented; but only with the view of determining whether it may not be possible in a very short space of time to initiate the process of defibrination of the blood contained in the sac, after which the process may continue until solidification is effected.[1]

Treatment of Aneurisms by Digital Compression.

According to his own statement, Prof. Vanzetti, of Padua, employed digital compression in the treatment of a popliteal aneurism at the hospital of Karkof in Russia, in 1846. Pressure was continued two days, and then finding this measure unsuccessful he resorted to the ligature. No account of this operation was published until 1858.

In the year 1847 Dr. Jonathan Knight, Professor of Surgery in Yale College, New Haven, made the first successful experiment with digital compression, a full account of which was published in 1848.[2]

Dr. Knight's patient was a mulatto man, aged 48. A popliteal aneurism had existed several months, and was of very large size. The limb was painful and œdematous. An attempt was first made to cure the aneurism by instrumental pressure; and for this purpose a variety of instruments were employed and successively laid aside, namely, the "hoop tourniquet," the "caliper-shaped instrument," and the common tourniquet, guarding, in the latter case, against the pressure of the strap by enclosing the limb in a thick case of sole-leather. However often the position of the pads were changed, and whatever apparatus was employed, so much pain was caused that it invariably had to be suspended, or so far relaxed within an hour as to render it inefficient. At the expiration of eight or ten days of persistent efforts, nothing had been accomplished, and Dr. Knight, with the concurrence of the patient's physician, determined to try "manual pressure." To accomplish this a number of students were procured from the medical class, who relieved each other every half hour, or as often as they might experience fatigue. Pressure made by the thumb or fingers upon the artery as it passed over the pubes was found to be sufficient to arrest the pulsation in the tumor, and this was directed to be kept up as nearly continuously as possible. No pain of consequence was experienced during the first five or six hours, nor at any time was the pain such that it was not relieved by the eighth of a grain of morphine once or twice repeated. At the end of eight hours pressure was suspended. The temperature of the limb was found to be diminished, and its size sensibly reduced, but the pulsation of the tumor returned as before. At the twentieth hour, upon suspension of the pressure, pulsation could not be felt in the tibial arteries, but no other changes had occurred. Treatment was resumed; and forty hours after pressure had first been applied it was again suspended, when it was ascertained that the tumor had ceased to pulsate; it was reduced one-third in size, and felt firm under direct pressure. Pulsation in the femoral artery could not be felt below Hunter's canal. Several anastomosing branches, and especially one passing over the inside of the knee, could be distinctly felt enlarged and pulsating. No farther treatment, except rest, was employed, and four months later the tumor had nearly disappeared.

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[1] NOTE.—Murray, of Newcastle-on-Tyne, has cured an aneurism of the abdominal aorta by "complete" pressure, made on the cardiac side during five hours, the patient being anæsthetized. Moxon and Durham, of London, were equally successful after ten and a half hours' compression; and Levis, of Philadelphia, has in the same way cured an aneurism of the external iliac in five hours and a half.

[2] Knight, *Transactions of the American Medical Association* for 1848, p. 169.

I have given a report of this case somewhat in detail because it illustrates the usual history of successful operations by the method of digital compression; and because some writers have seen fit to give to Prof. Vanzetti the credit at least of having first "fixed the attention of European surgeons" to the value of this method. Vanzetti did not, as we have seen, publish any account of his practice until ten years after Dr. Knight's case was reported in the Transactions of the American Medical Association.

During the same year in which Dr. Knight's case was published, his example was followed by Drs. Parker and Wood of this city, and in the succeeding years by several American surgeons. If the attention, therefore, of European surgeons was not sufficiently called to the value of this method at an earlier day it was because they did not read our journals, and did not know what was being done on this side of the Atlantic. It was certainly no fault of ours.

Free from many of the objections which pertain to instrumental compression, digital compression is deserving a trial in almost any case of aneurism in which the position and size of the artery will permit sufficient pressure to abate sensibly the force of the circulation.

Of twenty-three cases treated by digital compression, collected and tabulated by Dr. S. W. Gross, of Philadelphia,[1] fifteen were cured. Two of these were arterio-venous. In two cases of inguinal aneurisms the compression failed; and, as a rule, it may be stated that pressure of any kind cannot be made effectively above the pubes.

As to the period usually occupied in successful digital compression, it has varied from a few minutes to several days. Mr. Hart says that in a record of 19 cases the average period of pressure was not over 48½ hours, spread, however, over a variable period of time, owing to intermissions of the pressure.

Treatment of Aneurisms by Flexion.

This ingenious and simple modification of pressure applied to the cure of aneurisms was first successfully practised by Ernest A. Hart, Surgeon to the West London Hospital.[2] It has been found applicable to aneurisms situated in the popliteal space, and in the bend of the arm. Those cases are best suited for a trial of flexion in which the aneurism is small and free from complications, and which arise from the superficial surface of the artery.

In the case of a popliteal aneurism a bandage is applied from the toes to near the knee, from whence it is passed to the thigh, and the limb is thus secured at an acute angle. The thigh is then bent upon the pelvis, and the knee made to rest upon a pillow. If the amount of flexion necessary to obliterate pulsation in the tumor causes much pain, as I have seen happen in some cases in which I have resorted to this method, the flexion must be diminished and moderate digital or instrumental pressure may be employed as adjuvants.

In Mr. Hart's first case the cure was complete in four days; but in most of the cases reported, a longer time has been required for successful treatment.

Treatment of Aneurisms by Manipulation.

Mr. Ferguson, of King's College, London, attempted, in 1852, the cure of an aneurism of the right subclavian artery by a method which he terms "manipulation." The mode of procedure is essentially as follows: The tumor is compressed by the hand or fingers until its fluid contents are expelled, and then the walls are forcibly rubbed upon each other, or otherwise forcibly manipulated, with a view of thrusting some portion of its fibrinous clot into the channel of the emerging artery.

This method has not hitherto met with much favor with the profession, notwithstanding that several successful experiments have been reported. The force required to dislodge the fibrin exposes the patient to the danger of a rupture of the sac, and it is not possible always to prevent the escape of the clot in the direction of other channels than the emerging artery. Esmarch and Teale have each reported a fatal result of manipulation of the sac.

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[1] *North Amer. Med.-Chir. Review*, Jan., 1859.

[2] *London Med.-Chir. Trans*, vol. xlii., page 205: *Holmes' Surgery*, 1st ed., vol. iii. p. 425.

Treatment of Aneurism by Elastic Bandage.

A number of examples of the cure of aneurisms by compression and ligation effected by means of Esmarch's elastic bandage have been reported. The bandage is applied firmly to the surface of the limb, from its extremity upwards until it reaches the aneurismal tumor, which it is made to enclose less firmly, to be applied again more firmly for some distance above the tumor. The "tubing" or a firm, flat and almost inelastic band, is then fastened tightly around the limb above the last turn of the roller, and the roller is removed. The tubing is permitted to remain as long as it may be deemed safe to do so, after which the blood is permitted to return to the limb and the aneurism without interruption. Thus far the failures by this method have much outnumbered its successes.

Treatment of Aneurisms by Injections.

This method, first practised by Monteggia in 1813, proposes to establish a clot in the aneurismal sac through the agency of certain coagulating agents. For this purpose surgeons have suggested acetate of lead, acetic acid, tannin, and several other vegetable and mineral styptics, but the perchloride of iron has generally received the preference. None of these agents, however, are capable of producing anything more than a soft or passive clot.

The special dangers to which the method by injection is liable are displacement of the clot, with all the grave accidents which ordinarily ensue upon embolism, inflammation, suppuration, with gangrene of the sac and of the adjacent structures.

The first of these dangers can only be avoided by pressure sufficient to obliterate the arterial canal, made both above and below the aneurismal sac. The second must continue to exist until a coagulating agent can be found which is not at the same time irritating.

Treatment of Aneurisms by Galvano-puncture.

Electricity, in its application to the treatment of disease, has always experienced the most extraordinary vicissitudes in public favor, and in its application to the treatment of aneurisms the same violent changes of opinion may be observed. For the latest revival of its reputation we are especially indebted to the success and writings of M. Petriquin. Its triumphs are to-day numerous. Among the most favorable statistical results are those collected by Dr. A. M. Hamilton, which present forty-eight cures out of ninety cases in which galvano-puncture was employed.[1] I have seen it employed twice; once in the case of an aneurism of the abdominal aorta, and once in a femoral aneurism; and in each instance with no favorable results. The latter of these cases has not been published, and it is quite probable that a large proportion of the failures are unrecorded.

There is another view of the subject which ought to have great weight in determining the value of these statistics. The cases reported were, with few exceptions, examples of aneurisms of the extremities, and at the present day it is generally admitted that such aneurisms are most successfully treated by the ligature. According to Keyes, who, in connection with the report of a case of abdominal aneurism treated by himself by galvano-puncture, has written an excellent paper on this method of treating aneurisms, of twenty-three cases of aneurisms of the thoracic aorta, treated by galvano-puncture and tabulated by Luigi Ciniselli, only six are reported as cured; of these six, three relapsed. No reports were received from the remaining three at a later period than nine and a half months after the operations were made. Upon aneurisms of the abdominal aorta only two experiments have been made by galvano-puncture—one by Dr. Felice Dell'Acquia, reported in 1830 and one by Dr. Keyes, in March and April last, at the Charity Hospital. Both were unsuccessful. Dell'Acquia's patient died on the table; Dr. Keyes' patient survived the first operation one hundred and nine days, and the last seventy-five days, the operation having been repeated three times in all. At the autopsy of Dr. Keyes' patient no clot was found in the aneurismal sac.[2]

The object of the electro-galvanic treatment is to produce a gradual deposit of fibrin, but experience has shown that this is not always, nor indeed generally, attained; on the contrary, if coagulation is induced at all, it is by the formation of a soft clot in the majority of cases.

The patient is therefore exposed to the danger of embolus, very nearly to the same extent as where injections are employed, and the same precautions are requisite, such as pressure above and below the tumor, if we would avoid altogether the dangers of these fatal accidents. Nor is the method wholly exempt from the dangers incident to inflammation of the sac, and of the adjacent tissues. Hart says, in Holmes' Surgery, that of forty-three tabulated cases, thirteen have been the subject of grave accidents, and the remaining thirty of slight accidents.

Beard and Rockwell, in their excellent treatise on "Medical and Surgical Electricity," state that the electrolytic treatment of aneurism requires from five to twenty cells. They advise, indeed, that we shall not commence with the full power of the current, but that only one or two elements be employed at first, and that we gradually increase the number until the desired number is reached.

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[1] First Thesis Prize, College of Physicians and Surgeons, 1870, p. 14.

[2] *Practical Electro-Therapeutics; Galvano-puncture in Abdominal Aneurisms*, etc., by E. L. Keyes, M.D., *N. Y. Med. Jour.*, Dec., 1871.

Two or three needles, properly insulated, and connected with the negative pole, must be introduced into the aneurism, while a sponge electrode, connected with the positive pole, is applied to the surface near by.

The period of time occupied in each séance is usually from five to forty-five minutes; and at proper intervals this may be required to be repeated four or five times, although one séance has sometimes proved sufficient. Some operators prefer to employ for the electrolytic treatment of aneurisms the positive pole, while others have observed the best effects from the simultaneous introduction of both. The pain caused by the operation is usually such as to demand the use of an anæsthetic.

SECTION 2.—SPECIAL ANEURISMS, WITH ANATOMICAL INSTRUCTIONS FOR THE APPLICATION OF THE LIGATURE IN VARIOUS REGIONS OF THE BODY.

Radial Artery in the Lower Third.

The radial artery lies at this point between the flexor carpi radialis, and the supinator longus. The venæ comites lie closely upon either side, and the radial nerve quite remote on the radial side.

Operation.—The hand being held supine, an incision two inches in length is made on the radial side of the flexor carpi radialis. The integument and aponeurosis being laid open, the artery is at once brought into view.

Ulnar Artery in the Lower Third.

Resting upon the flexor profundus, the ulnar artery in this portion of its course is covered by both the superficial and deep fasciæ, and also by the radial margin of the tendon of the flexor carpi ulnaris, which latter constitutes the guide to the artery. The venæ comites lie in close connection on either side of the artery, and the ulnar nerve a little behind and to the ulnar side.

Operation.—While the hand is held in the supine position, an incision two inches in length is made along the radial border of the tendon of the flexor carpi ulnaris, and while the tendon is drawn slightly to the ulnar side, the incision is continued until the artery is exposed. In order to avoid the inclusion of the nerve in the ligature, it is best to introduce the aneurism needle from the ulnar side, between the nerve and the artery.

In the *upper part of the forearm*, both the radial and ulnar arteries are so deeply situated that the attempt to apply the ligature is very apt to do serious injury to the muscles and other structures, and, except in case of a direct wound of one of these arteries, the ligature is seldom applied in this region.

Brachial Artery at the Bend of the Arm.

At the bend of the elbow the tendon of the biceps constitutes the most important guide to the brachial artery. The artery occupies the centre of a triangle, two sides of which are formed by the supinator longus and the pronator radii teres, resting upon the brachialis anticus. The median nerve lies from one-quarter to half an inch to the ulnar side.

Operation.—The arm being extended, an incision is made two and a half inches in length, near the ulnar margin of the tendon of the biceps, leaving the median basilic vein to the radial side; the aponeurosis is then divided, and the tendon of the biceps exposed. To the ulnar side of the tendon, the artery with its small, venous satellites, will be seen. The forearm should now be flexed to remove the tendon of the biceps from the artery, and the ligature passed from the ulnar side.

Brachial Artery in the Middle of the Arm.

The brachial artery lies at first, in its course downwards, on the inside or ulnar margin of the coraco-brachialis; then on the inside of the biceps, which covers it a little in muscular subjects. The median nerve is in front of the artery, above, and rather to its outer side; about the middle of the arm it crosses the artery completely, and near the elbow it is upon the inner side. The artery is accompanied by its two satellite veins, with the internal cutaneous nerve in front. The ulnar nerve is, in the lower part of the arm, at some distance to the inner side. The musculo-spiral nerve is posterior to the artery.

Operation.—Extend the arm to a right-angle with the body, and hold it firmly supinated. The skin must then be divided along the internal margin of the biceps, to the extent of two or three inches; the fascia being carefully laid open, the median nerve will be at once brought into view as a large whip cord. Pushing both the nerve and the biceps a little to the outer or radial side, the artery and its venæ comites will be seen. Flexing the forearm, the vessel will be now more completely isolated, and the ligature can easily be passed from the radial side, between the median nerve and the artery.

Brachial Artery in its Upper Third.

The arm being held in the same position as for ligation in the middle third, an incision is made along the inner margin of the coraco-brachialis, when the artery will be found lying between the median and ulnar nerves, the former on its radial and the latter on its ulnar side. In dividing the superficial fascia, care should be taken not to wound the basilic vein which sometimes runs upon the surface of the artery as high as the axilla.

Subclavian Artery.

The subclavian artery is divided by surgeons into three portions, named, respectively, the first, second, and third surgical divisions. The first comprises that portion of the artery situated between its origin and the inner margin of the scalenus anticus; the second is that portion which is behind the scalenus anticus; and the third is that portion between the outer edge of the scalenus anticus and the lower margin of the first rib.

Subclavian Artery in its Third Surgical Division.

The subclavian artery passes downward after emerging from between the scaleni, and its pulsation can usually be felt most distinctly when the clavicle is depressed, and at a point above its upper margin, midway between its two extremities. It is at this point that it will be found generally most convenient and most safe to apply the ligature. The anatomical guides which I have been accustomed to give, differ in some respects from those usually described by surgical and anatomical writers. They are as follows:—

The approaches to the artery are through two well-defined triangles, one superficial and one deep-seated. The first, or supra-clavicular triangle, is formed by the sterno-cleido-mastoid, the omo-hyoid, and the clavicle. The second, or supra-costal, by the scalenus anticus, the brachial plexus of nerves, and the first rib. The latter triangle is quite small, and embraces the artery closely.

Operation.—The patient lying supine, with the shoulder well depressed by an assistant, an incision three inches in length is made over the superior border of the clavicle at its middle, dividing the integument, the platysma myoides, and, if necessary, the borders of the trapezius on the one hand and of the sterno-cleido-mastoid on the other. From this point the operation may usually be completed by the finger-nail, or by the instrument devised by myself and described in the preceding pages, guided alone by the pulsations of the artery. The external jugular vein, if exposed by the incision already made, must be seized by a blunt hook and drawn inwards; the finger is then to be placed upon the tubercle of the first rib, which corresponds to the insertion of the scalenus anticus, and while it rests in this position as a guide, the aneurism needle must be gently insinuated beneath the artery, taking care not to include any portion of the brachial plexus of nerves as it emerges upon the opposite side, situated above and to the outer side of the artery.

Subclavian Artery in the Second Surgical Division.

This operation is seldom made, on account of the danger of wounding the phrenic nerve, and for other anatomical reasons.

Operation.—The primary incisions are the same as in the case of the third surgical division, except that the knife has to be carried a little father inwards. The costal tubercle being recognized, a director must be passed beneath the scalenus anticus, and its division effected from without inwards. The phrenic nerve, which lies in front of the scalenus and near its inner margin, can only be avoided either by not making the complete section of the muscle or by pushing the nerve aside. The internal mammary artery also lies immediately outside of the phrenic nerve, and is therefore liable to be cut. In some degree, both of these dangers may be avoided by cutting the scalenus half an inch from its attachment, and by dividing it slowly in order to see whatever is brought under the edge of the knife. When the muscle is divided, the artery will be seen at once, and the needle can be passed from below upwards and inwards.

Subclavian Artery in the First Surgical Division.

On the right side this portion of the artery is short, and gives off six or seven considerable branches. Its anatomical relations are: in front, the skin, fasciæ, platysma myoides, and the origins of the sterno-cleido-mastoid, the sterno-hyoid, and the thyroid muscles. It is crossed, also, by the pneumogastric, cardiac, and phrenic nerves, and by the internal jugular and vertebral veins; behind, it is in relation with the recurrent laryngeal and sympathetic nerves.

On the left side the artery is longer, and is situated more deeply. In addition to the anatomical relations of the right corresponding portion, the left has, in front, the pleura and the lung; internally, the carotid, the œsophagus, and trachea; and behind, the thoracic duct.

Operation.—Dr. J. Kearney Rodgers, of this city, tied the left subclavian within the scaleni in the following manner: The patient being placed in the position above described, an incision three inches and a half long was made through the skin and platysma, on the inner edge of the sterno-mastoid, terminating at the sternum; this was met by another incision of two and a half inches, along the sternal extremity of the clavicle; the flap was dissected, and the sternal and half the clavicular origin of the sterno-mastoid divided on a director, and the flap raised; the deep fascia was then divided by the handle of the scalpel and the fingers, the dissection continued along the outer side of the deep jugular vein to the inner edge of the scalenus anticus muscle, to a point half an inch above the rib, to avoid the thoracic duct; the phrenic nerve was detected and avoided, and the fingers, pressed to the bottom of the wound, discovered the rib, and then the artery; the needle was then passed from below upwards.

Innominata.

The innominata is about one inch and a half in length, and bifurcates nearly opposite the right sterno-clavicular junction. It is in relation, externally, with the pleura, right vena innominata, and right pneumogastric nerve; behind, with the trachea; in front and above, with the sternum and the origins of the sterno-hyoid and sterno-thyroid muscles; below, with the inferior thyroid vein, and left vena innominata; and internally, with the carotid.

Dr. Valentine Mott was the first to attempt the application of a ligature to this artery, in May, 1818. The patient died on the twenty-sixth day, of secondary hæmorrhage. His mode of operation was as follows: The patient being placed on the back, the shoulders slightly raised, and the face turned to the opposite side, an incision three inches in length was made just above the cavicle, terminating over the trachea, and another incision, of the same length, extended from this point along the inner border of the sterno-mastoid. The integument was dissected off, and the platysma divided; the sternal and part of the clavicular portion of the sterno-mastoid were then divided on the director at the first incision, and turned outwards; the sterno-hyoid and thyroid were divided and drawn inwards, exposing the sheath of the carotid, par vagum, and internal jugular vein; the par vagum was separated from the carotid, and with the vein, drawn to the outside, while the artery was drawn towards the trachea, enabling the operator to expose the subclavian; the innominata was now reached by separating the cellular tissue, and the needle passed from below upwards and inwards.

There are now twelve well authenticated examples of ligature of the arteria innominata, only one of which was successful. In 1864, Dr. A. W. Smythe, of New Orleans, tied this artery for a subclavian aneurism. He tied also at the same time the common carotid one inch above its origin. Hæmorrhage having occurred on the fifteenth, thirty-third, and fifty-first days, Dr. Smythe applied a ligature to the right vertebral on the fifty-fourth day, after which the recovery was uninterrupted. Ten years later, the patient died from a recurrence of the hæmorrhage from the same tumor.

Primitive Carotid below the Omo-hyoid Muscle.

The carotid artery in the first part of its course occupies what is known in regional surgery as the inferior carotid triangle; which triangle is bounded in front by the median line of the neck, behind or externally by the anterior margin of the sterno-cleido-mastoid, and above by the anterior belly of the omo-hyoid. The artery is covered by integument, the platysma myoides, the superficial and deep fasciæ, the inner margin of the sterno-cleido-mastoid, by the sterno-hyoid and sterno-thyroid muscles. Situated very deeply and enclosed within a common sheath lie the carotid artery, the internal jugular vein and the pneumogastric nerve; the vein lying on the outer side of the artery on the right side of the neck, but overlapping or passing directly across it on the left side; the nerve is between the vein and artery, posteriorly. Filaments of the descendens noni lie in front of the sheath, and to the inner side.

Operation.—An incision, three inches in length, is made along the anterior border of the sterno-cleido-mastoid, commencing opposite the cricoid cartilage. The anterior border of the sterno-mastoid being exposed, it must be drawn outwards together with the middle thyroid vein. The sterno-thyroid and sterno-hyoid muscles must at the same time be drawn inwards, and the belly of the omo-hyoid exposed and drawn upwards. The deep cervical fascia being now laid open, the artery and vein enclosed in their common sheath will be exposed. Having opened the sheath, the needle must be introduced between the artery and vein, avoiding the pneumogastric nerve. Some care may be required also not to include the recurrent laryngeal and sym pathetic nerves, and the inferior thyroid artery, all of which lie behind the sheath. In case the ligature is applied in this region it should be placed as high as the circumstances will permit.

Primitive Carotid above the Omo-hyoid Muscle.

The superior carotid triangle is bounded externally by the sterno cleido-mastoid, above by the posterior belly of the digastricus, and below by the anterior belly of the omo-hyoid. The primitive carotid, which divides into the external and internal carotids opposite the cornua of the thyroid-cartilage, lies somewhat concealed by the margin of the sterno-mastoid, enclosed in a common sheath with the internal jugular and the pneumogastic nerve, the vein lying externally and the nerve on the same plane posteriorly, between the artery and the vein. The descendens noni is in front of the sheath near its inner margin.

Operation.—The portion of the primitive carotid above the omo-hyoid is more superficial and accessible than the portion below; it is regarded, therefore, as the point of election, and especially have operators chosen that point which is immediately above the omo-hyoid muscle. The patient is laid upon his bed with the shoulders elevated and his head turned to the opposite side. An incision three inches in length is then made along the anterior border of the sterno-mastoid muscle, commencing opposite the cornua of the thyroid cartilage. The superficial and deep fasciæ are divided and the sheath exposed. Carefully avoiding the vein and the descendens noni, the sheath is opened and the needle introduced from the outer side between the vein and artery.

If the knife is employed throughout the entire operation, small arterial and venous branches may require the ligature; but I have often completed the exposure of the sheath of the artery, after the first incision, by the handle of the knife, the "dry dissectors," or by the fingers alône, and without wounding a single vessel of sufficient size to demand the ligature. In some cases the internal jugular vein rises so prominently in front of the artery as to conceal it entirely. Pressure made at the upper angle of the wound will cause it to collapse partially, or it can be easily displaced by a blunt hook.

Arteria Dorsalis Pedis.

The continuation of the anterior tibial artery may be tied just before it dips down to the sole of the foot as it lies upon the internal cuneiform, and between the tendons of the extensor proprius pollicis and the innermost tendon of the extensor communis digitorum. It is accompanied by venæ comites, and upon its external side lies the continuation of the anterior tibial nerve. A fasciculus of the extensor brevis also crosses the artery obliquely at this point.

Anterior Tibial Artery near the Ankle.

The anterior tibial artery, covered by integument and fascia, lies, in the upper part of its lower third, between the tibialis anticus and the extensor proprius pollicis, and lower down over the instep between the extensor proprius pollicis and the extensor longus digitorum. It is accompanied by venæ comites, and the anterior tibial nerve, which latter is on the outer or fibular side.

The mode of procedure in the application of a ligature will not require a special description.

Anterior Tibial Artery in its Middle Third.

The artery here lies deeply situated upon the interosseous ligament, with its venæ comites upon either side, and the anterior tibial nerve upon its fibular side, and somewhat more superficial. It can only be reached by separating the muscular layers which compose the tibialis anticus on the one hand, and the extensor longus digitorum with the extensor proprius pollicis on the other.

Posterior Tibial Artery behind the Malleolus Internus.

The artery, with its satellite veins, is situated almost parallel with the posterior border of the internal malleolus, behind the sheath of the tendons of the flexor longus digitorum and the tibialis posticus. The posterior tibial nerve lies farther back towards the heel, but in close proximity to the artery.

Operation.—Make a crescentic incision behind the malleolus, with its convexity directed backwards, about midway between the tendo Achillis and the malleolus, but rather nearer to the latter than to the former. After cutting the deep fascia the artery will generally be found imbedded in a small mass of adipose tissue.

Posterior Tibial Artery in the Middle Third of the Leg.

Situated rather superficially, the artery runs parallel to, but about three-fourths of an inch from the internal border of the tibia, from which it is separated by the flexor longus digitorum. It is covered by the internal border of the soleus. The posterior tibial nerve is upon its tibial or inner side.

Operation.—The leg being flexed and laid upon its outer side, an incision is made two or three inches long, two-thirds of an inch from the inner edge of the tibia. The fascia being divided, the gastrocnemius is drawn aside and the fibres of the soleus divided, when the artery will be exposed.

Posterior Tibial Artery in its Upper Third.

Mr. Guthrie regarded the usual operations made for the ligature of this portion of the artery so dangerous, painful, tedious, difficult, and bloody, that he preferred to attempt to reach the artery by making a perpendicular incision of six or seven inches in length at the back of the leg, through the skin, fascia, gastrocnemius, soleus, and plantaris.

In case of a wound of the artery at this point, the application of a ligature might be required, and according to my own experience the surgeon will be best satisfied with his work who follows the advice of Guthrie

Popliteal Artery in the Upper Part of the Popliteal Space.

The popliteal artery may be tied with but little difficulty in the upper or lower portions of this space. In the middle, however, the application of the ligature is attended with more difficulty, owing to the greater depth of the artery, and the tension of the surrounding tissues.

Operation.—The patient being placed in the prone position, with the limb extended, an incision should be made about four inches in length, commencing a few inches above the internal condyle, and extending along the posterior margin of the semimembranosus. The fascia having been divided, the areolar tissue may be pushed aside with the fingers, when, by drawing the tendon of the muscle inward, the pulsations of the artery may be felt. The internal popliteal nerve lies much more superficial than the artery and to its fibular side, and is not seen in this dissection. The popliteal vein is also external to the artery, and more superficial, but throughout its course it is intimately connected with it. Separating the vein from the artery, the needle is carefully passed beneath the latter, which is then secured.

Popliteal Artery in the Lower Part of the Popliteal Space.

The patient being in the same position as before, an incision, three inches long, is made commencing opposite the bend of the knee-joint a little to the fibular side of the middle of the popliteal space, avoiding the external saphenous vein and nerve. Having divided the fascia, the dissection is continued with the finger through the areolar tissue to the space between the heads of the gastrocnemius, beneath which will be found the artery, with the vein and nerve, the artery being most external. After separating the vein and nerve, the needle should be passed from without inward.

Femoral Artery in the Fibrous Canal.

The artery here lies in a dense fibrous sheath formed of aponeurotic bands, which extend from the vastus internus to the tendons of the adductors longus and magnus. On either side are the bellies of the muscles just named, and anteriorly the artery is covered by the sartorius. The femoral vein lies internal to the artery and a little back of it, but in close apposition, and externally lies the long or internal saphenous nerve.

Operation.—The thigh being flexed upon the body, and the leg upon the thigh, the limb resting upon its external surface, an incision is made three inches long over the junction of the middle and lower portions of the thigh, on the outer or anterior margin of the sartorius, through the skin, fascia, and sheath of the sartorius, exposing the fibres of this muscle. Displace the muscular mass and carefully open its sheath posteriorly. Lay open the fibrous canal with the aid of a director, and the artery will be in view. The needle may now be passed from without inwards. In case the operator cannot recognize the situation of the sartorius, it will be remembered that the femoral artery follows very closely a line drawn obliquely around the thigh from the middle of Poupart's ligament to the middle of the popliteal space.

The operation is difficult, and is seldom practised except when rendered absolutely necessary.

Femoral Artery in the Lower Portion of Scarpa's Triangle.

In the upper portion of the thigh the femoral artery occupies the triangular space called Scarpa's triangle, bounded above by Poupart's ligament, externally by the sartorius and internally by the adductor longus. The artery lies superficially, being covered only by the integument and fasciæ, with a few lymphatic glands. The internal saphenous vein is also in front of the artery and a little to its inner side. Underneath Poupart's ligament the femoral vein, enclosed within the same sheath with the artery, is in contact and upon its inner side; toward the middle and lower portions of the thigh it gradually passes behind it, and in the upper portion of the popliteal space it is upon its outer side. The anterior crural nerve, as it emerges from underneath Poupart's ligament, is half an inch external to the artery. In the lower portion of Scarpa's triangle a branch of the anterior crural, the long or internal saphenous nerve, approaches the artery and runs along the anterior and outer margin of its sheath as far as the fibrous canal; it then leaves the artery and passes to the inner side of the knee.

The course of the femoral artery through Scarpa's triangle is from the middle of Poupart's ligament to the apex of the triangle. In the first part of this course the femoral artery gives off in rapid succession four small vessels, and finally the profunda, which latter is nearly equal in size to the femoral itself. The profunda arises from the outer and back part of the femoral, from one to two inches below Poupart's ligament.

Operation.—The brief review of the anatomy of this region above given will explain why the lower portion of Scarpa's triangle is usually selected for the application of the ligature in cases of popliteal aneurisms. The operation is made as follows: The thigh being slightly flexed upon the body, a little abducted and rotated outwards, an incision, three inches in length, is made along the inner margin of the sartorius, commencing about four inches below Poupart's ligament, leaving the internal saphenous vein to the inner side. The fascia lata is then divided, the sartorius exposed and drawn outwards, when the sheath of the vessels is at once brought into view. The sheath being opened, the ligature is passed from within outward.

Femoral Artery under Poupart's Ligament.

Operation.—The thigh being extended and rotated outwards, an incision is made, commencing at the middle of Poupart's ligament and extending downwards about two inches. The fascia is exposed by careful incisions, the sheath opened upon its outer margin, and while the vein is held inward the needle is passed from within outward. In very fleshy persons there is danger of mistaking the position of Poupart's ligament, and of placing the ligature too low.

External Iliac Artery.

The common iliac divides near the sacro-iliac symphysis. The external iliac passes obliquely downwards and outwards to its termination in the femoral under the middle of Poupart's ligament. It may be ligated in any part of its course except near its origin, where the proximity of the internal iliac would prevent the formation of a clot; and near Poupart's ligament, where the epigastric and circumflex arteries might, in the same manner, prevent the occlusion of the vessel, and thus give rise to a secondary hæmorrhage. On the left side, through its entire course, the external iliac vein is upon its inner side; on the right, this vein is at first behind the artery, and then to the inner side. In its upper part this artery is often crossed by the ureter. The spermatic vessels lie upon the external iliacs of each side, near their termination, and also a branch of the genito-crural nerve and the circumflex ilii vein; the vasa deferentia curve along their inner sides.

Operation.—The operation recommended by Sir Astley Cooper, and always preferred by Mott, will be found the most safe and easy of execution. It is essentially as follows: The patient lying upon his back, with the abdominal muscles relaxed, an incision is made three or four inches in length, parallel to Poupart's ligament, and about three-quarters of an inch above the ligament, terminating below at the external abdominal ring. After cutting through the integument, the superficial fascia and the tendon of the external oblique muscle, the muscular fibres of the internal oblique are exposed: detaching a few of these fibres from Poupart's ligament, near the lower or inner angle of the wound, the spermatic cord is brought into view: raising the loose cellular investment of the cord and incising it transversely, the finger may be readily passed beneath it through the internal abdominal ring, and at this point the pulsations of the external iliac artery may be felt directly underneath. The surgeon is now certain that he is below the peritonæum, and with gentle pressure he can displace this membrane with the contained viscera as far as may be necessary to expose fully any portion of the artery. The sheath of the vessels being opened, the ligature is passed from within outwards.

Common Iliac Artery.

The abdominal aorta divides usually on the left side of the body of the fourth lumbar vertebra, which point corresponds, in most cases, to the left side of the umbilicus. The common iliacs are about two inches in length, the right being the longest and largest, and are in relation anteriorly with the peritonæum and branches of the sympathetic nerve. Near the points where they divide into internal and external iliacs, they may be crossed by the ureters; on the right side this must be regarded as the rule, on the left as the exception. The left common iliac is crossed by the superior hæmorrhoidal artery, and the common iliac vein lies to its inner side.

The right common iliac has the iliac vein at first upon its outer side, then behind, and finally behind and a little to the inner side.

Operation.—The precise form and extent of the external incision must depend very much upon the obesity of the patient, or degree of projection of the abdominal parietes; the surgeon will therefore feel at liberty to deviate from the instructions given for the tegumentary incision according as his judgment shall suggest.

The patient resting upon his back, but inclining a little to the opposite side, an incision is made, commencing just in front of the free extremity of the eleventh rib, passing downward one and a half inches in front of the anterior superior spinous process of the ilium, and terminating just above the internal ring by a sharp curve upwards and inwards of an inch or more, the whole length of the incision being about seven inches. The three abdominal muscles being divided to the same extent, the fascia transversalis will be exposed. This must be opened very cautiously, first at the upper and outer part of the wound, where it is less closely united to the peritonæum; the opening in the fascia may then be enlarged, and the peritonæum gently displaced from below until the external iliac artery is brought into view, when the common iliac will readily be found. During the operation an assistant should stand upon the opposite side of the body, and with his hands in the wound sustain the peritonæum and the contained viscera. The surgeon must bear in mind also the danger of getting behind the psoas muscle while searching for the artery. In operating upon the left side the ligature should be passed from within out; on the right side the ligature may be passed either way.

The ligature was first applied to the common iliac by Gibson, of Philadelphia, for a gunshot injury, in 1812. The operation was unsuccessful. In 1827 Dr. Mott, of this city, made the first successful application of the ligature to this artery, in a case of aneurism. According to Agnew, the operation has been made sixty-three times, of which number fifty died, twelve are known to have recovered, and in one case the result is unknown. Of nine cases in which the peritonæum was wounded during the operation, only one recovered; and of thirteen cases in which the operation was made for hæmorrhage, but one recovered.

Very recently Dr. Gouley, of Bellevue Hospital, tied the common iliac in a case of aneurism of the external iliac, the patient dying in the course of a few days, of exhaustion consequent upon the sloughing of the sac, but not until after occlusion of the vessel had been completed; and on the 15th of May, 1864, after the battle of the Wilderness, I tied the same vessel in the presence of Dr. Walser and my student, Mr. Hoyn. The patient, John E. Preston, of the 19th Pa. Vols., had been wounded by a rifle-ball which had traversed the pelvis, and the operation was made to arrest a hæmorrhage, which had already nearly proved fatal. He died on the following day, but without a recurrence of the bleeding.

Internal Iliac Artery.

The internal iliac is a short but large vessel, of about one inch and a half in length, extending from the point of bifurcation of the common iliac downward to the upper margin of the great sacro-sciatic foramen. The internal iliac vein and the lumbo-sacral nerve lie behind the artery, the ureter crosses in front, and the psoas magnus muscle lies at its outer side.

The internal iliac was first tied successfully by Stevens, of Vera Cruz, since which time it has been tied successfully, either for the purpose of arresting hæmorrhage or for aneurism, by White, Valentine Mott, Syme, and several others.

The mode of exposing the artery usually adopted is the same as in applying the ligature to the common iliac.

Aorta.

Sir Astley Cooper was the first to attempt the application of a ligature to the aorta. His operation was made in 1817, in a case in which an inguinal aneurism had ruptured and death was imminent. He made an incision three inches in length, a little to the left of the umbilicus, entering the cavity of the peritonæum. Separating the intestines, the peritonæum was opened over the artery with the finger-nails, and the ligature applied three-quarters of an inch above its bifurcation. The patient survived forty hours.

Since then the ligature has been applied to the abdominal aorta seven times, in one of which cases modified acupressure was employed. Some of the operators have imitated the method adopted by Sir Astley Cooper for the purpose of reaching the artery, and others have kept entirely outside of the peritonæum. In one of these latter cases the patient survived ten days; but in all the remaining examples death resulted within a few hours.

CHAPTER XVI.

FRACTURES.

SECTION 1.—GENERAL CONSIDERATIONS.

Definition and Nomenclature.

A **FRACTURE** is a solution of continuity in bone or cartilage, occasioned by violence.

Fractures are divided into complete and incomplete, single or simple, comminuted or multiple, compound, complicated, double, transverse, oblique, longitudinal, serrated, denticulated, impacted, and punctured.

A fracture is said to be **Complete** when the line of fracture traverses completely the length or breadth of the bone.

An **Incomplete** fracture is a partial separation, and is understood to include,—First, a *bending* of the bone, in which, although there may be no appreciable separation of fragments, a certain amount of lesion is assumed to exist. It has been called "interstitial" and "interperiosteal."—Second, a *partial fracture*, or green-stick fracture, which is common in the bones of infants and children, and which is, also, in most cases denticulated.—Third, *fissure*, or the incomplete fracture of older and less flexible bones, common in the bones of the skull, and in gunshot fractures of the extremities, and which is seldom or never denticulated.

In a **Single** or **Simple** fracture the bone is broken at but one point.

The fracture is said to be **Comminuted** or **Multiple** when the bone is broken at two or more points.

A fracture is **Compound** when there is an external wound communicating with the point of fracture.

The term **Complicated** is reserved for other complications than those already specifically named: thus a fracture may be complicated with a dislocation, with lesion of important nerves or blood-vessels, with a syphilitic taint or other general dyscrasiæ.

A fracture is termed **Double** when the same bones on the corresponding sides of the body are broken: as when both clavicles are broken.

The terms **Transverse, Oblique,** and **Longitudinal** indicate the direction of the line of fracture in relation to the long diameter or axis of the bone. A transverse fracture, strictly speaking, seldom occurs in the shafts of long bones.

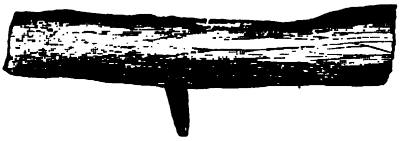
Serrated fractures, or those fractures in which are presented one or more angular projections like the teeth of a large saw, occur usually at or near the extremities of long bones, and are not so common in infancy and in youth as in more advanced life.

Denticulated fractures, presenting long, slender spicula of bone, occur most often in the shaft and near the centre of long bones, and belong almost exclusively to early life.

Impacted fractures are those in which one fragment is driven into another; and this variety of fracture is illustrated most often in extracapsular fractures of the neck of the femur, in fractures of the surgical neck of the humerus, and in the so-called Colles's fracture, near the lower extremity of the radius.

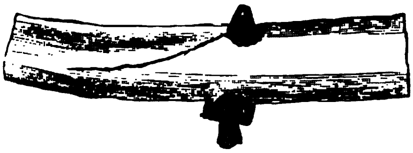
Punctured fractures are caused by penetrating weapons, such as the bayonet and the arrow, and in civil practice are most often observed in fractures of the skull. In military practice they are most frequently met with as the result of gunshot injuries, and of bayonet or arrow wounds in the epiphyses of the long bones. Ordinarily they are accompanied with fissures. In the following wood-cuts two examples of punctured fractures of bones are represented, caused by arrows, in one of which there is not even a fissure connected with the fracture.

Fig. 54.



Section of a Buffalo rib, with impacted arrow-head. No. 4735, sect. 1, A.M.M. Circular No. 3, 1871.

Fig. 55.



Section of a Buffalo rib, with impacted arrow-head and fissure. No. 4736, sect. 1, A M.M. Circular No. 3, 1871.

Writers often apply other names to fractures, according to certain real or fancied resemblances, as for example, *en rave*, *en bec de flute*, *en bec de plume*, spiroid, cuneate, the silver-fork fracture of the radius.

When bones are separated by violence at the point of junction between their epiphyses and their diaphyses, the accidents are termed *epiphyseal separations*. These separations take place most frequently in early life; they are in general nearly transverse; often accompanied with only moderate displacement, and they are in most regards subject to the same rules of diagnosis and treatment which govern other fractures.

General Causes of Fracture.

The causes of fractures are predisposing and exciting.

The **Predisposing Causes** are old age, mollities ossium, fragilitas ossium, rachitis, scrofula, cancer, lues, gout, scorbutus, mercurialization, and probably all diseases which materially impair the tone of the general system.

Youth predisposes to the occurrence of partial, and old age to the occurrence of complete fractures, and especially of the so-called "pipe-stem" fracture.

As contrasted with dislocations, the difference in the liability at certain ages is very marked. In youth and old age fractures are common, while during these periods of life dislocations are very rare. In middle life fractures and dislocations are about equally common.

The **Exciting** or **Immediate causes** of fracture are chiefly mechanical violence and muscular action.

Mechanical or external causes are observed to operate in two ways: first, by direct contact with the limb over the point at which the bone gives way, in which case it is called a "direct" fracture; second, by contact with the limb at a point remote from that at which the bony lesion occurs, when it is called an "indirect" fracture, or a fracture "by counter-stroke."

In many cases where bones break under muscular action alone, there is known to be a general predisposition to fractures, as is proven by the frequent or repeated occurrence of fractures from slight muscular effort, in the same person. In not a few cases, however, bones are broken by the action of the muscles when no such predisposition exists. I have once seen the femur broken in a strong, muscular man, while in the act of rolling a ball in playing ten-pins.

The bones which are most frequently broken by this cause are the patella, the humerus, the olecranon process of the ulna, the femur, the tibia, and the calcaneum, but nearly all the long bones of the body have been broken at one time or another by muscular action.

The causes of **Intra-uterine Fractures** remain in some measure conjectural; at least this remark is true of a majority of the cases which have been reported.

In most of the examples there have been some reasons for supposing that they were occasioned by external violence, or by blows received directly upon the belly of the mother. In other cases they have been believed to be caused by contraction of the womb of the mother, or by some malposition and entanglement of the limbs of the child; no doubt, also, a rachitic condition of the bones was responsible for all those examples in which the child has been born with a number of fractures in different parts of the body. Chaussier mentions a case in which there were one hundred and twelve fractures; and I have recorded the case of an infant four days old, in whom nearly all the bones were completely separated at their epiphyses; motion of the fragments being accompanied with crepitus.

I have met with examples of fracture caused by the hands of the accoucheur in forcible delivery; and with one example of fracture of the humerus, apparently caused by the contraction of the neck of the uterus while the child was entering the world. Other cases similar to those last mentioned have been reported.

General Signs of Fracture, and Differential Diagnosis.

There are three general signs, which are present, with only occasional exceptions, in all fractures, and which I have called "common" signs, in contradistinction to the "special" signs which belong to each particular fracture. These have also great importance as means of differential diagnosis between fractures and dislocations.

The three common signs are crepitus, mobility, and the fact that when the fragments are reduced they will not generally remain in place without mechanical aid.

Crepitus, caused by contact of the broken surfaces with each other, is generally a rough, grating sensation. If, however, the fracture has existed several days or weeks, the sensation is more subdued, and after a time, although no union may have taken place, it ceases altogether.

In partial and denticulated fractures the sensation is often that of a click, as if sharp spicula of bone had been brought in contact and suddenly separated.

When a fracture has existed some days without union, the crepitus may so closely resemble the albuminous chafing in joints inflamed by dislocation as to lead to an error in diagnosis.

Crepitus is not always present, either because the broken ends can not be brought into contact, or because of impaction or of denticulation, and consequent immobility of the fragments.

Preternatural Mobility, when it exists near the centre of the shaft of a bone, or at any point except in the vicinity of joints, must be conclusive evidence of the existence of a fracture; but it is absent in many cases of partial or denticulated fracture, and of impacted fracture.

Spontaneous Displacement.—Fractures, when reduced, do not generally remain in place without mechanical aid. This sign of fracture, which I have ventured to add to those commonly enumerated, is quite as constant as either of the others named. It results from the fact that most fractures of long bones are oblique, and cannot for that reason be maintained in contact without support. Even in the few cases of transverse fractures which are now and then seen, it is observed that in most examples the action of the muscles, if unrestrained, will speedily cause displacement. The reverse is generally true of dislocations. As a rule, after reduction in the latter case, displacement will not again occur unless as a consequence of the renewed application of violence.

There are a few other phenomena attending fractures which are less constantly present, but which are recognized as signs of fracture, such as angular deformity, transverse or rotary displacement, separation of fragments, as in fractures of the patella. There is often inability to lift the limb, owing to pain, or to the separation of the bony lever upon which the muscles act; but this inability does not extend to all fractures, and especially does it not exist in all partial or impacted fractures. Swelling and pain are symptoms common to this and to many other accidents. Ecchymosis is more constantly present in fractures than in dislocations.

It will aid the surgeon very much, in arriving at a correct diagnosis in certain obscure cases, to consider the age of the patient, and the manner in which the accident occurred. The influence of age, in its relation to both fractures and dislocations, has already been explained. If the fracture is occasioned by a counter-stroke, as when the tibia breaks in consequence of a fall upon the foot, the bone, in most cases, gives way not far from the point where the impulse is received. For example, the tibia breaks generally in its lower third; a fall upon the hand breaks the radius, in nine cases out of ten, within one or two inches of its distal extremity; a fall upon the elbow breaks the humerus often just above the condyles; and a fall upon the shoulder breaks the clavicle at the junction of its outer with its middle third. In advanced life, however, frequent exceptions are found to this rule. A fall upon the foot in old age will generally break the neck of the femur within the capsule; a fall upon the elbow will break, in many cases, the surgical neck of the humerus; and even the tibia is at this period not unfrequently broken near its upper end by a fall upon the foot.

In infancy, bones are more prone to give way near the centres of their shafts, and at the point of junction between the epiphyses and diaphyses.

Fractures from counter-stroke have in general a greater obliquity than fractures from direct blows. The fragments also, being driven past each other with force, overlap to a greater extent; the soft parts are often more extensively lacerated, and blood-vessels are more apt to be penetrated.

On the other hand, fractures from direct blows are often more nearly transverse, generally more comminuted, but the overriding is less. The soft parts are, perhaps, less lacerated, but they have usually suffered greater contusion.

Fractures which occur from muscular action are in general pretty nearly transverse, and the fragments are seldom displaced. They are not accompanied with either laceration or contusion, and are seldom followed by much swelling. The cure is therefore accomplished in these cases speedily, and in general without deformity.

One of the most valuable aids in the diagnosis of fractures is measurement; but whether this means has been employed for the purposes of diagnosis, or to determine the result after the union was consummated, surgeons have seldom appeared to me to understand the conditions of a faithful measurement; and as a consequence, they have too often deceived both their patients and themselves as to the length of broken limbs.

If the diagnosis cannot be completed on account of the suffering which every attempt to handle the limb inflicts upon the patient, it will be proper to place him under the influence of an anæsthetic; but let the surgeon be admonished that although the patient may be insensible, it is just as possible now to do irreparable injury, by violent manipulation, by pressing, pushing, and thrusting the ends of the broken bones into the flesh, as if the subject of these manipulations responded to every motion by cries and moans. I have seen more than one death from this cause. It is certain that those surgeons who handle broken limbs rudely are either very stupid or very inhumane, but there are some men who never do otherwise; and the only hope for the patient who is so unfortunate as to fall into their hands is, that he still retains sufficient consciousness, and sufficient strength of voice and of limb, to successfully defend himself. If such surgeons as I have described are permitted to practise, they ought not, at least, to be allowed to render their patients insensible by anæsthetics.

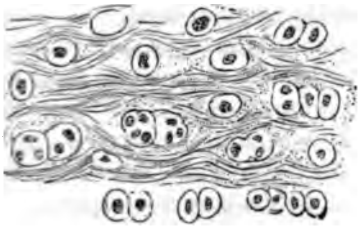
Repair of Fractures.

When a bone is broken and the periosteum torn,—which latter circumstance happens in all fractures of bones except in a few of those incomplete fractures called interperiosteal,—a laceration of blood-vessels in the medullary tissue, the bone, and the periosteum ensues; and in most cases more or less of the soft parts surrounding the bone, including their blood-vessels, are also torn. There results from these lesions an immediate extravasation of blood at various points. Soon after, if the system of the patient is in a normal condition, or in a condition not greatly below the average of health, hyperæmia occurs, followed by inflammation, with serous and plastic effusions into all the adjacent structures. The periosteum becomes more vascular, thickens, or swells near the seat of fracture by a process of proliferation from its under surface, and by the consequent formation of concentric laminæ of new tissue. The medullary tissue near the seat of its lesion, also, becomes more vascular, and a process of proliferation commences therein. This increased vascularity is not confined to the medullary tissue of the interior of the bones, and to the periosteum, but extends in some degree to the structure of the bone itself, and to the soft structures external to the periosteum. The progress of repair in the periosteum, if the ends of the fragments remain perfectly in contact and without any lateral displacement, and if they are kept sufficiently at rest, insures a speedy union of the divided portions of the periosteum. The same result occurs in the case of the lacerated medullary tissue in the interior of the bone, unless extravasated blood or some other cause interferes with its reunion.

The precise period at which the process of ossification commences cannot be stated. In general it may be said to be between the fifth and twentieth day: this period being delayed more or less according to the age and general condition of the patient, and according to the size and position of the bone implicated. It commences earlier in young bones, in persons of good health, and probably earlier in the bones of the upper extremities than of the lower. The bones of the face, the lower jaw, and the clavicle generally unite more quickly than other bones of the body.

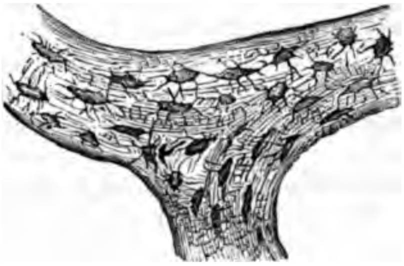
The new bone or callus is derived from the periosteum, the medullary tissue, the broken surfaces of the bone, and from such portions of the connective and other soft tissues as, having suffered laceration, are in the vicinity of the fracture. When the laceration and displacement are the least, other things being equal, the amount of callus is the least. It is probable that neither hyperæmia nor inflammation is essential to the repair of lesions in bone, as they are probably not essential to the repair of lesions in the soft parts; yet these pathological conditions are seldom absent in either case, and if they do not materially aid in the restoration of divided parts, it is certain that when moderate they do not prevent such restoration. There is a condition below the average of health, in which even the normal process of repair is delayed or arrested, and which effectually prevents both the union of bone and of soft parts, while, on the other hand, excessive inflammation proves equally destructive to this process; but this latter cause operates by excess, and consequent imperfection of the process, rather than by the actual default of proliferation.

Fig. 56.



Fibro-cartilage, formed between the broken ends of a fractured femur.

Fig. 57.



New osseous structure from same specimen.

The transition of the original cell formations, from whatever source they may be derived, into bone, may be through granulation tissue, fibrous tissue, cartilage and fibro-cartilage, or calcification may occur simultaneously with the formation of fibrous tissue.

The deposit or formation of bone corpuscles is not generally from a single point or centre, as in the ordinary processes of crystallization, or of accretion, forming long spindle-shaped projections; nor is it, in most cases, derived from a few central points which branch outwards until their opposite extremities meet and become fused. If such were the fact, motion of the fragments during the process of union, by causing the fracture of these delicate spindles, would effectually prevent union. That certain motions, and within moderate limits, do not prevent union, I shall hereafter illustrate; and they do not, for the reason that the new bone is deposited in a multitude of points, throughout the connective, fibrous, cartilaginous or fibro-cartilaginous tissues which constitute the stroma. Even when a large portion of this stroma is converted into, or replaced by osseous corpuscles and masses of corpuscles, the stroma still remains flexible, and the bone may be bent moderately at the point of fracture without disturbing the process of union.

When all of the lacerated tissues in and around the point of fracture are thus more or less infiltrated with bone corpuscles, and their interspaces have become lost by impaction, motion of the fragments ceases, and they are said to be united.

At this period there is in general an excess of bony structure or of callus; the medullary canal is more or less occluded by it, and there are irregular and superabundant deposits externally; while, if absolute and perfect contact has been maintained, as in certain impacted fractures, the ends of the bone are completely united.

This new structure still remains, however, soft and spongy, and contains more than its normal amount of connective, perhaps of cartilaginous tissue; and it is not until a much later day that by absorption of these elements, and by other assimilating processes, the redundancy is removed. Even the medullary canal is eventually restored to the shafts of the long bones, and the bone assumes its natural, solid, compact form, with all the anatomical characters of the original bone.

The account which has now been given of the union of broken bones was founded upon the assumption that the fragments were in exact apposition, end to end, or that they were perfectly "set" in the popular acceptation of this term. But it is well known that a large majority of the long bones once broken are never "set" end to end, and thereafter maintained in this position until the cure is completed.

The plan of union adopted by nature in these cases does not, however, differ from that which has been described, except in this, that, whereas, in the former and less frequent example, the periosteum may unite to periosteum, around the entire circumference of the bone, the medullary tissue to medullary tissue, and the bone to bone at the opposing extremities of the fragments, and these may all become the media for bony union—in this latter and much more frequent example, the bones overlapping and only remaining in contact at their sides, or upon very oblique and more or less displaced broken surfaces, there will be direct union only of such portions as are in contact; the callus will be deposited more extensively because of the greater laceration, and more irregularly because of the inequality of bony surface; the open ends or hollow cylindrical canals of the fragments will still be closed in by new bone, derived mainly from the medullary tissue; the rough broken surfaces will be rounded by absorption and new deposits; the periosteum will perform its part in the process; so that finally, and often quite as soon as if the ends were in contact, the fragments will be found united side and side, with a sufficient abundance of callus filling all the irregularities to render the union as strong as if the union had taken place end to end. It is the same process as that first described, varied only by some irregularity in the deposit. In most cases, after the lapse of a sufficient time, the medullary canal will be found to have become continuous across the line of fracture, by absorption of the opposing lamellated walls, and consequent perforation at the point where the fragments overlap.

When the inflammation connected with fracture results in suppuration, the formation of osseous tissue is delayed, in consequence of the destruction of the connective tissue, and in consequence of the failure of those transitional tissues through which bone is usually developed.

And when finally union is consummated, the deposit of callus is generally irregular, and sometimes excessive.

Epiphyses, when broken or separated from the diaphyses by violence, unite by the same process as other fractures of bone. It is observed, however, that when certain epiphyses are separated, and are mal-adjusted, such for example as the lower end of the femur, or the head of the humerus, the shafts cease to grow, and the limbs become atrophied.

True cartilage is rarely broken, many of the supposed examples in old persons being in reality fractures of a structure which was originally cartilage, but which has become converted into bone. When broken, it never unites by cartilage. In the case of a fracture of the cartilage of the ribs, the perichondrium supplies usually a sort of ferrule of bony tissue, which is, however, sometimes interposed between the opposing fragments. In the case of the fibro-cartilaginous structures, such as the intervertebral substance of the spinal column, and the synchondroses, the union is generally by fibrous or ligamentous tissue.

If a fracture extends into a joint, through the cartilage of incrustation, the bone may unite, but the cartilage does not.

General Treatment of Fractures.

There are three general indications of treatment in most fractures, namely, to reduce the fracture, to maintain it in place, and to control or prevent inflammation and other accidents.

It has already been stated that in a certain proportion of fractures of long bones, it is impossible to set the bones end to end, so that the coaptation of all the broken surfaces shall be complete and perfect; and for the reason that it is often impossible, even when the patient is under the influence of an anæsthetic, to overcome sufficiently the contraction of the muscles; or because of denticulations, or of small and loosened fragments, or of shreds of the soft tissues, which are interposed between the broken surfaces. Indeed, this difficulty is experienced quite as often in transverse, or in nearly transverse, fractures as in oblique.

In a still larger proportion of cases, constituting a vast majority of the whole number of complete fractures of the shafts of long bones, it is impossible to maintain them in exact apposition until the consolidation is effected; and we need not be surprised at the inefficiency of our art in this regard, when we consider that, with very few exceptions, these fractures are oblique, and in most cases the obliquity is such, that the slightest force acting in the direction of the axes of the bones will displace them, not to make account of the action of the various muscles in causing lateral displacement; and especially when we consider what advantages the muscles possess over any mechanical appliances which we can employ. The muscles—themselves capable of exerting enormous power, especially when provoked by injury—have their insertions directly or through the interposition of the periosteum upon the bone, from which they cannot be easily detached; while the appliances with which we attempt to overcome their action must be made to bear upon soft, delicate, yielding integument, which is easily excoriated and inflamed, and which is supported underneath by a mass of equally delicate and yielding tissues, subject to congestions and inflammations; and the ligation of or direct pressure upon which endangers the arrest of both nervous and vascular circulation, with all their consequences.

If, therefore, the student of surgery is instructed that his first duty is to reduce the broken bone, and his second duty is to maintain it in position, he will not understand that he is required always, or even in the majority of cases, to do more than put the limb carefully in line, to extend it until the overlapping is diminished to the minimum of what is consistent with the endurance and safety of the skin and other soft parts which support the extension, and perhaps to aid still further in the prevention of overriding by properly constructed side supports. In short, to do whatever can be done prudently to adjust and maintain the fragments in place.

The means to be employed to produce and maintain extension, can only be studied in connection with the special fractures which create their necessity.

The means employed by surgeons to give lateral support are numerous, and to some extent demand consideration in this place.

In general it may be said of lateral supports, that they serve the purpose of retaining the fragments in line, of obviating motion at the point of fracture, of preventing that lateral displacement which is sometimes due to the action of antagonizing muscles, and, moreover, they often co-operate efficiently with proper extending apparatus in maintaining extension: when no other means of extension can be employed, they must be relied upon alone to perform this function.

A few surgeons have sought to dispense with lateral supports altogether, whether in the form of splints or bandages, maintaining that they are mischievous, by the interruption which they cause to the circulation and nutrition of both the soft parts and the bone, and that in all cases extension may be substituted. It is not true, however, that they ever prove mischievous in the manner supposed, unless they have been applied with inordinate tightness, or for a great length of time; and even when these errors in management have been committed, the examples in which the splints or bandages have interfered with union are so rare that, in the multiform varieties of both good and bad treatment to which I have seen fractures subjected, I have never happened to meet with a case of delayed union from this cause.

If, however, such results did happen in consequence of excessively tight bandages much more often than they actually do, it would constitute no argument against their proper use, especially since in many other points of view they are indispensable.

Side or coaptation splints may be constructed of various materials, according to the convenience of the surgeon, or according to their adaptation to the peculiar circumstances of the case.

In general the requisites of a good splint may be said to be sufficient firmness, flexibility, malleability, or capacity of adaptation, and lightness.

Metallic splints, such as tin, copper, and zinc, usually possess in some measure all of the above qualities except lightness. The perforated zinc splint, employed to some extent in the United States army during the late war, has an advantage over either of those mentioned in its quality of flexibility, and also in its relative lightness. Iron wire-gauze splints, introduced first by Dr. Nott of Mobile, galvanized and varnished, and formed upon wooden patterns, can scarcely be considered superior to the perforated zinc.

Whalebone, reeds, light willow branches, and unbroken wheat straw may be quilted between two thicknesses of cloth, and thus form a suitable substitute when other materials are not at hand.

Wooden splints made of pine or of white wood may be employed in a great variety of cases. I protest, however, against those carved wooden splints which are manufactured and sold under a pretence that they are already adapted in size and form to every limb, when in fact it is impossible that they should be. In nearly every case in which they are applied, those very irregularities in form which are designed for adaptation are the causes of mal-adaptation and discomfort.

Wooden splints may properly enough be carved for any particular case; but in general they will answer the purposes for which they are especially designed if they are well padded with cotton batting upon their inner surfaces, the padding being so arranged as to fit the irregularities of the limb, and being held in place by a cover of cotton cloth. The cotton cover, in addition to its utility in retaining the wadding neatly in place, will always be found of service as a basis upon which the bandages may be made secure by pins or stitches.

Pasteboard can often be conveniently employed as a substitute in the absence of better materials; but it is not sufficiently firm, even when thoroughly dry, to prove reliable, and I have often seen its employment entail deformities, which by the use of a firmer material would probably have been avoided.

Compact woollen cloth, or felt, saturated with gum shellac, makes a very solid and light splint, and one which is capable of a good deal of adaptation. The most serious objection to its use is that it requires nearly the temperature of boiling water to render it plastic, and that it hardens so quickly in cooling that sufficient time is not always allowed for its proper adjustment.

Gutta-percha possesses in a remarkable degree most of the attributes of a good splint. Its plasticity is unlimited; so that it may be made to enclose and fit smoothly and accurately any joint, at whatever angle the limb may be placed; when softened by warm or hot water, it does not harden sensibly until it is sufficiently cool to be tolerated by the skin; but it becomes firm soon enough not to occasion delay in the application of the dressings. This material requires some experience and skill in its application, but surgeons who are accustomed to its use will seldom employ any other material in fractures occurring in the vicinity of certain joints, and especially in fractures involving the elbow-joint.

Undressed sole-leather, cut into shape and moistened with water, has been much employed by surgeons. Its cheapness, accessibility, plasticity, and its firmness when dry, render it available, both in public and private practice, in the large majority of fractures. Of late years I have used a splint made of four or six thicknesses of cotton cloth, pressed together with gum shellac, which, like the felt, is manufactured by the hatters. It is much firmer than the felt, and more plastic than the leather, and on the whole I regard it as superior to any splint now in use.

From time to time a great variety of immovable forms of dressing have been recommended for the treatment of fractures, which are intended to serve, at the same moment, the double purpose of splint and bandage. They all possess, also, certain other qualities in common. They are composed of bandages or of strips of cloth, saturated with some adhesive material, which, being applied to the whole circumference of the limb while moist, soon become dry and hard, constituting therefore, in some sense, an immovable apparatus,—that is to say, they can only be removed by cutting them open longitudinally.

For this purpose cotton cloth or common roller bandages have generally been employed, moistened with gum arabic and whiting, the whites of eggs and flour, starch and alum, gum shellac, pitch, wheat-flour paste, starch, dextrine, or plaster-of-Paris.

Whatever its advocates may have claimed for these modes of dressing, if I state the results of my own experience, I am compelled to say that they possess but two qualities of marked excellence and superiority, namely, their perfect adaptability to almost every degree of flexion or angularity in a limb, and, as I shall explain presently, they have, in a few exceptional cases, an advantage in their immobility.

The uniformity and smoothness with which they may be made to enclose joints when in a position of flexion, is, however, a point of excellence in which gutta-percha enjoys a decided pre-eminence over these and every other form of dressing yet devised. Nevertheless, when gutta-percha is not at hand, some of the forms of immovable apparatus may justly be entitled to preference, in certain fractures demanding the support of joints in a flexed position. In most other fractures, sole-leather, felt, gum-shellac cloth, and padded wooden splints can be made to adapt themselves to all the inequalities of surface.

By the term immobile, employed to designate these dressings, its advocates have not intended to convey the idea that they could not be removed whenever the surgeon thought it proper to do so; for although their removal might not be so easily and quickly effected as in the case of other dressings, yet they have all recommended and practised occasional removal and replacement. They are simply not liable to accidental disarrangement or displacement, and in this sense only are they immobile. In order that there might be no misunderstanding upon this point, M. Seutin has thought it proper to designate these dressings by the term "mobile immobile."

In so far, then, as they are more difficult to open when it is necessary to open them, they are objectionable; and how much real advantage they possess in not being liable to spontaneous or accidental displacements, ought to be easily determined by practical surgeons.

I have already stated, when speaking of the delayed union of bones, that I am accustomed to open my dressings often, in order to make certain of the condition of the limb, and of the position of the fragments. The difficulty of doing this in immovable forms of apparatus has led generally to its total omission, and the result has in very many instances proven exceedingly disastrous. When at length the dressings have been opened, the limb has been found lying unsupported in its encasement, in consequence of the dressings having become loose by drying, or of a subsidence of the swelling, or of an atrophy of the limb. In other cases, the limb having continued to swell, it has become unduly compressed and ligated, causing, in several instances reported, sloughing of the parts below the ligation, sloughing of the integuments over the point of fracture, ulcerations and excoriations; and in a large proportion of cases, from lack of attention to their condition as the union progresses and the swelling subsides, the fragments are found at length united with unnecessary deformity.

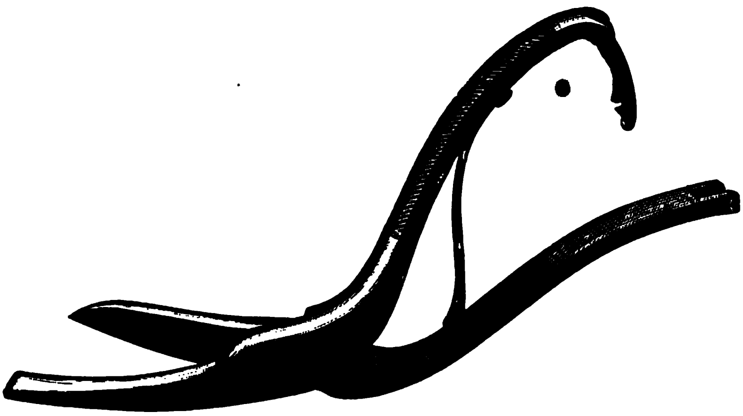
On the whole, therefore, with few exceptions, all of these forms of dressings have been found by myself eminently unsatisfactory.

Whenever, in the exceptional cases named, it is deemed proper to use these dressings, wheat-flour paste, boiled starch, or plaster-of-Paris, are in general to be preferred; and preliminary to their application, all the projecting angles of bone, especially in the vicinity of joints, should be well covered with cotton batting, or the whole limb should be enclosed in soft woollen cloth. The first turns of the roller, whenever the batting or cloth is not underlaid, should be applied dry. Occasionally, thin pieces of pasteboard may be employed to re-enforce the dressings, especially in the leg and thigh.

In order to open or remove these dressings, a pair of M. Seutin's or Henry's pliers are almost indispensable. The latter will generally be preferred.

Plaster-of-Paris, in the form of moulds, has been employed from a very early period, but plaster-of-Paris bandages were first introduced by Mathieson and Van der Loo of Holland. The usual practice has been to envelop the limb with a dry roller, and to apply the plaster with a paint brush as the successive turns of the roller are laid upon the limb. It hardens very quickly, and in this regard it has an advantage over flour paste or starch; but it is heavy, and not so generally accessible, and for these reasons its use is more restricted.

Fig. 58.



Henry's Plaster-bandage Cutters.

At Bellevue one method of using the plaster-of-Paris dressing is as follows: The limb is first carefully shaven, and very slightly moistened with sweet oil—much oil will prevent the crystallization of the plaster—and then enveloped with one single sheet of coarse woollen cloth which has just been immersed in the liquid plaster. This method, which commends itself by its simplicity, leaves the limb open and exposed on one side, so that it is no longer, in its proper sense, an immovable apparatus. After the plaster has become sufficiently dry, it is secured more effectually in place by a few turns of a roller.

Another method, which we have adopted occasionally of late, is as follows:—The limb is first enclosed with a single sheet of woollen cloth, the irregularities being filled up and protected by cotton batting. A dry roller is then applied, and over this a succession of rollers, into the meshes of which dry plaster-of-Paris has been previously rubbed, and which have been immersed in hot water for a few minutes preceding the application.

Dr. E. Harris, of this city, has ascertained that the weight may be considerably diminished by mixing it with water in the proportions of 75 to 100 by weight, and adding 2 parts of boiled starch—the latter delaying the process of crystallization until a large portion of the water has escaped.

When employed in the service of troops upon the field, the plaster must be put up in cans hermetically sealed. In this way it was furnished to the surgeons, by the U. S. Sanitary Commission, during our late war.

Comminuted fractures require no special consideration in this place, unless it be to say that the treatment is to be conducted with more care and watchfulness, in proportion to the additional difficulties and complications which they usually present; and that if they are compound as well as comminuted, it will occasionally, but not very often, become necessary to remove small and very loose fragments of bone.

Compound fractures constitute a larger and much more grave class of accidents than that class in which the bone is simply comminuted or broken at two or more points, without any other complications; but very many compound fractures are also comminuted, and in these examples especially the injury may be considered as grave. A pretty large proportion of these latter demand immediate amputation; and those limbs which are saved exact often extraordinary care to secure a tardy and vicious union; so that limbs which have united with great shortening and much deformity ought often to be regarded as triumphs of our art, inasmuch as that they have been saved at all.

In many of these cases neither coaptation splints nor extension can be employed until the period is nearly or wholly past in which they can prove of much value; the surgeon being compelled to rely upon such imperfect substitutes as junks, pillows, boxes inlaid with some soft material, etc. These are the cases which tax the ingenuity of the surgeon to the utmost; and for the general management of which he must be left to his powers of invention and judgment, as the indications arise from day to day.

The fragments of bone should be reduced as perfectly as possible; and if any point of bone protrudes, it should be brought underneath the integuments either by extension of the limb, or by pulling the skin aside with the fingers, or with the handle of an iron spoon, or some other sufficiently firm instrument. If these measures do not succeed, the skin may be slit open freely; but my experience does not lead me to recommend excision of the bone, unless it be of a small portion of an exceedingly sharp spiculum. Enlarging the opening does not generally complicate the case—sometimes it is even advantageous—while the practice recommended and pursued by some surgeons, of closing the wound with adhesive plaster and bandages, and thus preventing the escape of effused fluids, has very often proven disastrous. The treatment of these accidents by hermetic sealing and carbolic acid will be discussed more fully hereafter.

Nearly all the attempts in these cases to secure the fragments in apposition, by metallic sutures, have failed to be useful; and the effort has sometimes proved actually injurious.

One of the most simple methods of managing compound fractures of the leg is that devised by J. Rhea Barton, of Philadelphia, called the "bran box;" but as its use is almost limited to this fracture, it will be more properly considered when treating of fractures of the lower extremities.

When, in the progress of the treatment of compound fractures, fragments become necrosed, they are not to be removed until a complete spontaneous separation has taken place between the dead and the living. If they are removed by the saw or the bone-cutters, the injury thus inflicted upon the living bone will, in most cases, insure the death of another fragment, and, consequently, a delay in the final cure equal to the time necessary for its separation also.

If vessels bleed freely and persistently, it may be worth while to attempt to secure them in the wound, but such attempts are not generally successful; and if bandages, or other suitable means of compression, if cold, or styptics, do not succeed, and if ligation of the main trunk nearer the heart is not expedient, then amputation becomes the only alternative.

Impacted Fractures.—In many cases of impaction of fragments it is not easy to overcome the impaction, and generally it is not desirable to do so; as, for example, in cases of impaction of the neck of the femur, or of the humerus. When the impaction is not disturbed, side or coaptation splints are seldom needed. The union takes place speedily and with only moderate shortening or deformity.

Partial Fractures.—In most cases the surgeon is able, with the application of slight force, to restore the partial or "green-stick" fractures of children nearly to a straight line; but it is often very difficult to restore them completely. In a majority of the examples of partial fracture of the clavicle, the bending is slight; and owing in part to the difficulty of seizing the clavicle, and for other reasons which I shall presently state, its position is seldom materially changed by the efforts of the surgeon. When, however, the radius and ulna are bent, the flexion is generally much greater; but the surgeon may, by the application of moderate force, bring the bones nearly into their normal position. The difficulty in completing the restoration in these latter cases consists solely in the fact that the projecting spicula of bone become crushed between the broken surfaces, or abut against each other. The same circumstance explains, in part, the difficulty of complete restoration in the case of the clavicle.

Where it is practicable to do so, as in the case of the arm, forearm, or leg, I have not hesitated to employ sufficient force to render the fracture complete, which has enabled me to rectify the position at once. One need have no apprehension that by so doing the ends will become displaced and slide past each other, since the denticulations will effectually prevent this.

It ought to be understood, however, that in almost all cases where the clavicle or other bones have been left in children slightly bent, eventually they have been restored spontaneously to their natural form; a fact which finds its explanation in the resiliency of the un broken bone structure, where it has been compressed forcibly opposite the line of fracture, and in the gradual absorption of the crushed or abutting spicula.

SECTION 2.—DELAYED UNION OF BROKEN BONES, AND NON-UNION.

The causes of delayed and non-union are predisposing and direct; in other words, constitutional and local.

The constitutional or predisposing causes are those morbid conditions of the general system which manifest themselves by anæmia and debility, or which consist in some peculiar dyscrasy. Thus, for example, the formation of callus is occasionally delayed by extreme age, by low fevers, by profuse hæmorrhages, by pregnancy and prolonged lactation, by the absence of an accustomed stimulant, by low diet, by the presence of a scorbutic or of a syphilitic taint, by cancer, rachitis, etc. It may happen, however, and probably generally does happen, that the presence of either one of these morbid conditions neither prevents nor appreciably delays bony union.

The local or direct causes are motion at the point of fracture, the interposition of a detached fragment of bone, or of a shred of muscle, ligament, or possibly of a large blood-clot, between the fragments; arrest of the arterial circulation by bandages too tightly applied and too long continued; arrest of the nervous circulation from the same cause; arrest of the nervous and vascular circulation from too much elevation of the limb, from long-continued cold and moist applications, the occurrence of suppuration, caries, or necrosis. Finally, the union of fractures is delayed or prevented whenever the line of separation is wholly or partly within a synovial or articular surface, owing to the fact that in these cases comparatively little aid, in the accomplishment of this process, is given by the adjacent soft tissues, and perhaps to the fact that the broken surfaces are constantly washed by the synovial fluid. In certain cases of non-union of articular fractures special causes probably concur with those already assigned, which will be more appropriately considered in connection with each individual fracture.

Motion has been mentioned as one of the causes of delayed union, and the fact that it may prevent union is indisputable, yet surgeons have generally over-estimated its influence in this direction. There are few bones in the body which unite more quickly and more certainly than the clavicle and the ribs, notwithstanding the fact that the first generally remains overlapped, and that in both it is found almost impossible to completely restrain motion during the progress of consolidation. It has been my practice, in the case of many fractures, to open the dressings so as to bring into view the surface of the limb whenever I entertained the slightest doubt as to whether its condition might be improved, and, after the lapse of a few days, to inflict slight motion upon the limb, for the purpose of determining the progress of repair, nor have I ever seen any harm result from this practice. No fracture treated by myself, not compound or comminuted, has ever refused to unite.

Slight motion made upon the point of fracture, as upon a pivot, does not retard union, but very free motion made in the same manner is likely to produce this result. The motion, however, at the point of fracture by which one fragment is made to slide up and down, in the direction of the axis of the bone, or to move to and from, in a direction at right angles with the axis, seldom fails to delay or to prevent altogether bony consolidation. By these motions the new granulation tissue or the fibrous bands are greatly elongated, and the deposit of bone corpuscles does not keep pace with their formation and elongation; and when the intermediate tissue has its anatomical character fully established, bony infiltration is an improbable, if not an impossible event.

Precisely why slight motion does not prevent bony union, the manner in which the bone corpuscles are deposited will sufficiently explain. As has already been stated, they are not disposed eccentrically, from a single point or centre of ossification, but they are deposited at a multitude of points in transitional stroma.

These principles will find, hereafter, practical illustration in fractures, not only of the clavicle and ribs, but also in the humerus, femur, tibia, and other long bones.

The development of callus may be obstructed from the beginning, or it may be arrested at any stage of its progress, and the so-called "false" joints may therefore present a great variety of anatomical conditions.

First: In case of a complete failure of the process of repair, both on the part of the soft parts and of the bone, so that not even the medullary spaces are filled in, necrosis and suppuration become inevitable; and, if union ever takes place, it is only after the termination of the process of exfoliation and suppuration.

Second: The repair may proceed so far as to close in the medullary canal, or the open cells of the broken surfaces, the ends of the fragments may become somewhat rounded and smooth; and here, so far as the union of the ends of the fragments is concerned, the process may cease, and even a retrograde action may take place, as in the case of the neck of the femur within the capsule, by which considerable portions of the broken ends may be removed; but at the same time the soft parts adjacent to the fracture usually become converted into fibrous or ligamentous tissue, forming a more or less perfect capsule. At first this capsule is only fibrous; but if sufficient time elapses, and the false joint is kept in motion, it may eventually become lined with a true synovial, secreting surface. In process of time, also, the ends of the fragments may undergo other changes due to their continual pressure and friction upon each other. They may acquire a certain adaptation to each other, with corresponding depressions and elevations. They may become in vested with a fibro-ligamentous, fibro-cartilaginous, or even with a cartilaginous tissue, resembling the natural cartilage of incrustation; or by a retrograde process the ends may become condensed, polished, and eburnated, losing their character as lamellated bone structure, and being converted into a structure resembling ivory.

Third: The soft tissues adjacent to the fracture may not only form a fibrous investment, more or less compact, but the ends of the bones may themselves become united by fibrous tissue, or even fibro-cartilaginous tissue, and here the process may be arrested. In a few cases of this class the continued motion of the fragments causes the partial separation and lamellation of the interposed fibro-cartilaginous structure, and something like an interarticular cartilage is formed.

Treatment of Delayed Union.—Examples are quite frequent in which, bony consolidation being delayed from one cause or another beyond the usual period, the timely and judicious employment of certain measures have secured the consolidation. This happens most often, according to my experience, in the case of the tibia; yet it is exceedingly rare that this bone refuses finally to unite. The causes which in this special instance so often occasion delay are, in most cases, a peculiar motion of the fragments upon each other at the seat of fracture, which will be more particularly explained when speaking of fractures of the tibia, and, added to this, impairment of health by long confinement in bed. If, under these circumstances, well-formed leather or any of the various forms of immovable splints are applied, and the patient is permitted to leave his bed and go about upon crutches, the union is, in a large proportion of cases, speedily accomplished.

The delay of union in fractures of the humerus, as will be stated more fully hereafter, is due often to similar causes, and consolidation may be effected under a similar plan of treatment.

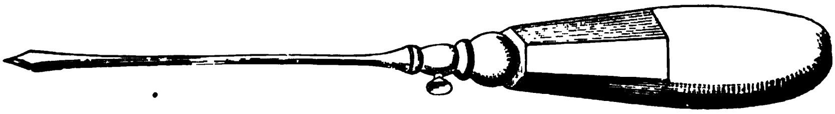
In short, it may be said that in most cases of delayed union the formation of callus may be hastened by change of posture and improvement of the general health. In some cases benefit has been derived from exciting some degree of reaction or inflammation in the vicinity of the fractures by moving the broken ends upon each other with violence, by the application of blisters, or by the employment of electricity. These measures, and especially blisters and electricity, must, however, be regarded as in general of much less value than those to which attention has just been called.

Treatment of Non-united Fractures.—The distinction made between delayed and non-union, has reference only to lapse of time. In case consolidation is not completed within the usual period, or after a delay of several months, it is termed delayed union; and in these cases there may remain a reasonable ground of hope that the union will take place without surgical interference. If consolidation is not completed within a period of several months or years, it is termed non union, and some operative procedure will probably be required.

The seton, first suggested by Winslow in 1787, was successfully employed by Physick in 1802. Physick used for this purpose silk ribbon, which was introduced, whenever practicable, between the ends of the fragments, and permitted to remain several months. Various modifications of this practice have been adopted, none of which possess any features entitling them to special consideration or preference. Thus, for example, Oppenheim placed two setons, one on each side of the bone; Sommé substituted a loop of wire; Seerig carried the seton around the fibrous connecting band, and then gradually tightened it until it fell out; Dieffenbach perforated the overlapping fragments and the intermediate tissue with a drill, and then introduced ivory pegs; Gaillard, of Louisville, Ky., proposes to perforate both fragments with a metallic trocar and canula.

Malgaigne, in 1837, perforated the tissues connecting the two fragments with an acupuncture needle, but without success. Miller, in 1848, employed successfully subcutaneous puncture with a tenotomy knife; Detmold succeeded with a gimlet, in 1848, in a case of ununited femur; and still later Brainard invented and used a drill with an awl-shaped extremity. The instrument devised by Brainard is preferable to either of the others mentioned, in case it is proposed simply to perforate and immediately withdraw the instrument. It consists of a series of well-tempered steel drills, somewhat broader near their cutting extremities than in their shafts, mounted in one or more handles.

Fig. 59.



Brainard's Perforator or Drill, reduced one-half.

I have employed this method several times with complete success, but it has occasionally failed. The drill must be pushed down to the bone and made to perforate it freely through and through at several points, at and near the point of fracture. It is not necessary, however, in most cases to make more than one wound in the soft parts. After the operation splints are to be applied with great care, and perfect immobility secured for a period of several weeks. In case of failure the operation should be repeated after the failure is fully declared.

In 1828 M. Mayor having thrust a canula down to the point of fracture, carried through this an iron shaft previously heated in boiling water, and after repeated applications of the iron a cure was accomplished.

Caustics and even the actual cautery have been applied to the ends of the bones after free incision. The ends have also been exposed and removed by rasping.

The operation of resection, practised from the earliest time, has probably furnished the largest number of successful results. Roux succeeded after resection in engaging the point of one of the fragments in the medullary canal of the other, and thus secured their union. The practice is generally to wire the ends together after resection, and to maintain complete quietude by the aid of splints.

Resection, as a remedy for non-union, is not applicable where, from the resistance offered by paralled bones, the ends cannot subsequently be brought into contact. If, therefore, resection is practised upon the tibia, the fibula being sound, or upon either one of the bones of the forearm, care must be taken that no more than the overlapping extremities of the fragments are removed. If there is no overlapping, this operation is inadmissible. The great depth of the femur has rendered its resection more hazardous and less successful than has been the case with other bones. The greatest triumphs have been always in cases of ununited fractures of the humerus.

If none of the measures enumerated seem expedient, or if one or more of them, having been fairly tried, have proved failures, the only remaining resorts are to mechanical supports, or to amputation. It has occasionally happened that under the use of well-contrived mechanical supports alone the fragments have gradually, and after the lapse of several years, become united by bone, or by a very compact fibrous tissue which has served the purposes of bone. This fortunate result is, however, exceedingly rare.

SECTION 3.—GUNSHOT FRACTURES.

Gunshot fractures are such as are occasioned by missiles projected from weapons mostly employed in warfare. They are therefore a class of accidents belonging appropriately to military surgery Nevertheless they are not confined to military practice, and may properly demand attention in a general treatise.

These fractures are characterized by several features peculiar to themselves; while in many respects they do not differ from fractures resulting from other causes.

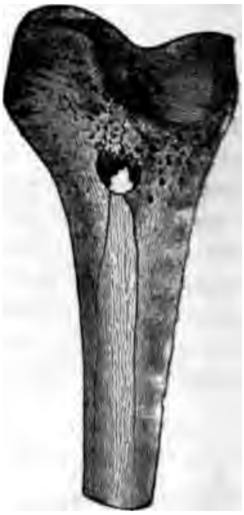
They are caused mostly by direct blows, the force being applied to a limited space, and in general acting with great power. They are therefore in nearly all cases compound, comminuted, and often fissured. Sometimes they are simply perforations of bone, or perforations with fissure.

Small shot sometimes penetrate a short distance into the spongy tissue of the epiphyses of long bones, or into small and soft bones; they may also cause contusion and necrosis of the superficial laminæ, but they seldom produce a true fracture. In most cases where they have reached the bones, they are found flattened and spread out upon the surface, or they have been deflected and lodged in the surrounding soft tissues.

Round balls, also, are frequently deflected by solid bone structure, but they frequently break solid shafts and penetrate spongy bones, causing in the latter case perforations which are very often unaccompanied with fissures.

Conical rifle-balls are, however, by far the most destructive, generally causing extensive comminution, and rarely perforating spongy bones without causing fissures. Their greater relative weight and velocity are the chief causes of their greater destructiveness; and possibly, in some cases, their peculiar form, in consequence of which they penetrate like a wedge, may be responsible for the comminution and the fissures.

Fig. 60.



Perforation, with Fissure.

Longitudinal fissures are sometimes, though very rarely, unaccompanied with complete fracture. When the shaft of a long bone is broken and comminuted by a ball, even where the point of fracture is several inches from an articulating surface, a fissure has been found extending through the epiphyseal connection fairly into the joint; generally, however, it terminates at the epiphysis. If a conical ball has penetrated an epiphysis, it almost invariably causes a fissure which invades the joint. These perforating wounds of the epiphyses are therefore among the most serious complications of gunshot fractures in the vicinity of joints.

When a ball has traversed and comminuted a bone, no loose fragments are usually found upon the side of entrance, but upon the opposite side are more or less detached and displaced fragments; and sometimes, especially in the case of perforations, numerous small fragments, entirely detached, may be found lying in this portion of the track.

Solid cannon-shot, shell, chain and bar shot, shrapnel, grape and canister cause such extensive destruction as can seldom be repaired, and amputation or resection become the only proper surgical alternatives. In a few cases some of these large missiles impinging only upon the sides of limbs, or their momentum being nearly expended, occasion simple or comminuted fractures which admit of repair.

Treatment.—If the surgeon determines to make an attempt to save the limb, the first indication of treatment, after the arrest of hæmorrhage, is to remove, as far as practicable, all foreign substances from the wound. This consideration includes the removal not only of the ball, or such portions as may happen to remain, pieces of clothing, etc., but also, in some cases, of fragments of bone. I entreat the surgeon, however, to understand that here, as in all other comminuted fractures, loosened fragments of bone are not always foreign substances. So far from this is the fact, that in many instances they are essential to the final union. For example, if either the tibia or the fibula alone, or the radius or the ulna alone are broken, and the loosened and displaced fragments are all removed, a space will be left between the main fragments which the process of repair will fail to supply, and non-union will be the result. The same may happen where much bone is removed, even in the case of the femur and humerus, and of other long bones which are not prevented from approximation by parallel bones. I have seen many unfortunate illustrations of this meddlesome kind of surgery. Limbs have been rendered useless by the failure to unite; or, as has happened quite as often, the attempt, by dissection and by forcible application of the forceps, to remove the fragments has given rise to a fatal hæmorrhage, or to a destructive inflammation.

Fragments which are completely detached from the soft parts as well as the bone, ought of course to be removed if practicable. It is also proper to remove certain loose and much displaced fragments which lie near the surface, and which do not involve the whole diameter of the bone, especially if they have very sharp points which are goading the flesh; and occasionally a needle-shaped point may be cut off by the bone-nippers.

What spicula remain will become eventually so many links of connection, forming an irregular union; but almost any union is better than none at all. Even in those cases in which more or less of the fragments eventually become necrosed, their temporary preservation has often proved useful. During the progress of the inflammation which has preceded their death, an abundant callus has been thrown out from the periosteum, and has contributed to the union; so that, although the occurrence of necrosis is unfortunate, and delays the final closing up of the wound, especially when the dead fragment becomes imprisoned by the callus, yet this result even is not always without its compensations.

A certain number of speedy recoveries, after a clean removal of all the loose fragments in gunshot fractures of the shaft of the thigh, and of the shafts of other long bones, and a few cases of equal success after complete resection by the saw, with or without the union by wire, have not changed my convictions upon this point. In my experience, if the comminution of the thigh was very extensive, the patients have generally died unless amputation was speedily made. Resections have not generally saved them; and among the cases of recovery after this operation which I am able to recall, there are not a few who are encumbered by useless limbs. The same remarks apply with more or less force to similar examples of gunshot fractures of the shafts of most other long bones. It will not be forgotten, however, that the upper extremities possess a much greater tolerance of injury and power of repair than the lower; and that certain lesions which would inevitably demand amputation of a thigh or of a leg might not suggest a question as to the chance of saving the limb in the case of the arm or forearm.

The remaining indications of treatment are the same as in most other fractures, namely, to reduce the fracture and to maintain the fragments in place. After the explanation which has been given of the proper meaning of these terms, "reduction" and "maintenance," no misapprehension can exist as to what is intended by their use in this connection. The fragments are to be placed, as near as their condition and the condition of the patient will permit, in a natural position, and there maintained by appropriate means. It is scarcely necessary to say that if we fail generally in simple fractures of accomplishing by our appliances all that we desire, we may expect to fall very greatly short of complete success in these complicated accidents. We must anticipate serious deformity as the most favorable result.

In the subsequent pages, when considering "special fractures," I shall have occasion to refer again to gunshot fractures, and shall then speak somewhat more in detail of the rules which govern their management in particular cases.

SECTION 4.—SPECIAL FRACTURES.

Fractures of the Ossa Nasi.

A VERY slight displacement of the nasal bones may occasion a serious disfigurement of the face. It is important, therefore, that the displacement should be early recognized and properly overcome. It happens, however, that in a large proportion of cases the true nature of the accident is not ascertained until the swelling has subsided, and it is too late to apply the remedy. In all cases where a blow has been received upon the nose, a careful examination should be promptly instituted, and, if a fracture has occurred, a smooth steel sound, of small size, should be carried to the roof of the nares and the fragments carefully adjusted. No means of support hitherto contrived, unless it be transfixion by needles, as practised by Mason, merit consideration. The patient must not snuff forcibly, or blow through his nostrils; neither compresses nor adhesive plasters must be laid over the nose; and if with these precautions the fragments do not keep their places, then the surgeon must observe daily, as the swelling subsides, whether they are in position, and, if they are not, he should carefully readjust them each day. Fractures of the nasal bones unite very early, and, unless the deformity is remedied within the first ten or fourteen days, the result of surgical interference must be considered doubtful.

Fractures of the Cheek Bones.

That portion of the superior maxilla which supports the malar bone is so frail, that a force wholly insufficient to break the latter is often sufficient to comminute the former; so that it is not a fracture of the malar bone with which we have generally to deal, but a depression of this bone upon the antrum.

If the malar bone is but slightly depressed it should be let alone. If the depression is extreme, the antrum should be penetrated from below, and the bone forced up with some suitable instrument. In some cases this may be accomplished by the finger introduced into the mouth and placed under the zygomatic process of the malar bone.

If the zygomatic arch is driven in, although the temporal muscle may be for a time paralyzed or embarrassed in its motions, these symptoms, in most cases, soon disappear, and no permanent injury ensues. If in any case it is thought necessary to elevate the depressed fragments, the only reliable method is to cut down upon the bone and lift the fragments with an elevator or a pair of forceps.

When the alveolar arcade is broken or the superior maxilla extensively comminuted, the fragments should be replaced as well as possible, and retained in position by the lower jaw, or in some cases by wire ligatures applied to the sound teeth. The exceeding vascularity of these parts insures their speedy reunion, even when the fragments are very much loosened or almost completely detached.

Fractures of the Lower Jaw.

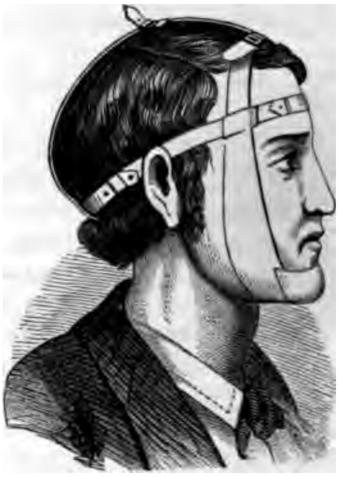
The lower jaw may be broken at or near the symphysis, in the body or horizontal portion, at the angle, in the ascending ramus, through the condyles, or through the coronoid process.

The most frequent point of fracture is in the body, near the anterior mental foramen. When a fracture occurs at this point the anterior fragment generally falls two or three lines, and sometimes is slightly displaced backwards upon the posterior fragment. The indication of treatment is simply to elevate the chin; and if all the teeth remain in both the upper and lower jaws, a perfect coaptation is secured when the jaws are closed and maintained in apposition; but inasmuch as under these circumstances the patient could not be fed, we are not permitted to adopt this method, unless the absence of one or more of the teeth in the front of the mouth leaves a sufficient opening for the introduction of a tube. Where all the teeth are perfect, therefore, we find it necessary to introduce between the molars, on one or both sides, interdental splints, which, at the same time, give a support to the lower jaw, and separate the front teeth sufficiently for the introduction of food. For this purpose, wood, cork, ivory, and other materials have been employed; but gutta-percha, recommended first by myself for these cases in 1849, is in many respects superior to either. It is useful, also, whenever the absence of the molars in either jaw will not allow the upper dental arcade to furnish a proper internal support or splint to the fragments.

Nearly all the bandages and slings recommended for this fracture are inefficient, and are exceedingly liable to displacement. That portion of the apparatus especially which, in most forms of dressings, passes in front of the chin and is made fast under the occiput, intended only to prevent the sling from sliding forwards, does not fail to depress the chin, and increases the tendency to overlapping of the fragments.

I have been able to overcome these difficulties in some measure by an apparatus constructed as follows.

Fig. 61



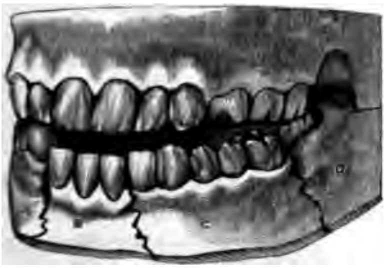
The author's apparatus for Fracture of the Inferior Maxilla.

A firm leather strap passes under the chin, and is buckled over the top of the head at a point near the junction of the coronal and sagittal sutures. This maxillary strap—as it will be convenient to designate it—is stayed by two counter-straps made of linen webbing, called respectively the occipito-frontal and the vertical. The occipito-frontal is looped upon the maxillary at a point just above the ears, and may be elevated or depressed at pleasure, to fit different heads. The posterior, or occipital portion of this strap is buckled under the occiput; while the anterior, or frontal portion is buckled across the forehead. The vertical strap unites the maxillary and occipital, passing over the top of the head in the line of the sagittal suture. Wherever a buckle is used, a pad should be placed underneath it. The maxillary strap is constructed of firm leather, to prevent it from becoming easily displaced forwards at any point below the counter-straps. Under the chin it is narrow, but immediately widens as it passes over the sides of the jaw and face, becoming narrow again in front of the ears. To prevent its being displaced backwards against the larynx, a piece of linen cloth should be fastened to its margin in front of the chin. This is most conveniently done by punching holes in the anterior margin of that portion of the maxillary strap which corresponds to the chin, and then fitting and sewing fast the chin-piece after the apparatus has been once perfectly adjusted.

There are a few cases of compound comminuted fractures, and especially gunshot fractures, in which other forms of apparatus may be required. Occasionally it may be necessary to secure the fragments with wire looped over sound teeth, or passed through the fragments themselves. Ligatures of any kind, however, made fast to the teeth, are liable to several objections. They are apt to slide down upon the gums; they gradually loosen the teeth; and, operating horizontally, they act to a great disadvantage. Dr. Prout of Brooklyn has succeeded, in one case under my observation, in obviating this last objection, by fastening the wire to the crowns of the teeth and securing it over a piece of gutta-percha, laid along the top of the dental arcade, and across the line of fracture.

Attempts to secure the fragments by interdental splints combined with outside splints, thus dispensing with the sling, have been made by Chopart, Desault, Rutenick, Kluge, Bush, Houzelot, Jousset, Lonsdale, Malgaigne, Wales, and others. They are generally complicated, and seldom possess any advantages to compensate for the trouble and expense of making and applying them.

Fig. 62.



Plaster Model of Jaws.

The use of vulcanized rubber, suggested by Gunning and Beans, as an interdental splint, made fast in some cases with screws worked into the teeth, has also only a limited application. In the hands of an ingenious dentist, however, this material may be made very useful in certain comminuted fractures. Dr. Beans' success during the late war in the treatment of gunshot fractures, after the subsidence of the immediate inflammation, has completely established its value in these cases;[1] but the vulcanized rubber apparatus invented by Norman Kingsley, dentist, of this city, in point of simplicity and effectiveness, exceeds any which I have yet seen. This latter has been employed in a number of cases at Bellevue Hospital, and in no case has it failed to give entire satisfaction.

Kingsley's apparatus may be thus briefly described. Impressions of the upper and lower jaws are taken in plaster-of-Paris; models made from these impressions represent the lower jaw broken, and the fragments displaced. The model of the lower jaw is then separated at the points of fracture, and the fragments are adjusted to the model of the upper jaw. Upon the plaster model of the lower jaw, obtained and rectified in this way, the vulcanite is moulded, embracing the teeth and the steel arms; the latter, constructed of wire, one-sixteenth of an inch in diameter, rise abruptly at points corresponding to the angles of the mouth, curve forward and then outward, so that, when in position, the two outer extremities shall terminate over the surface of the cheek at a point nearly opposite the base of the coronoid process. When the apparatus is applied the teeth must be pushed into the sockets of the splint with some force. The dressing is now completed by a sling made of strong muslin extending from one arm to the other beneath the chin.

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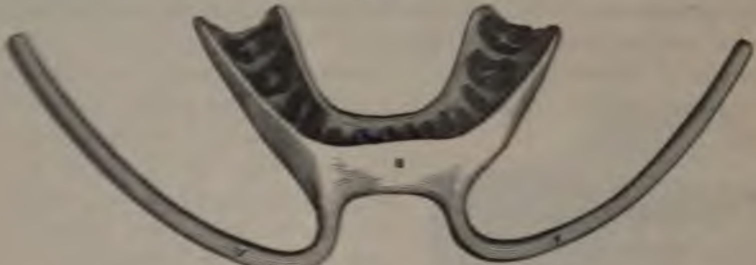
[1] Beans. *Richmond Med. Jour.*, Feb., 1866. Also the author's *Treatise on Fractures and Dislocations*.

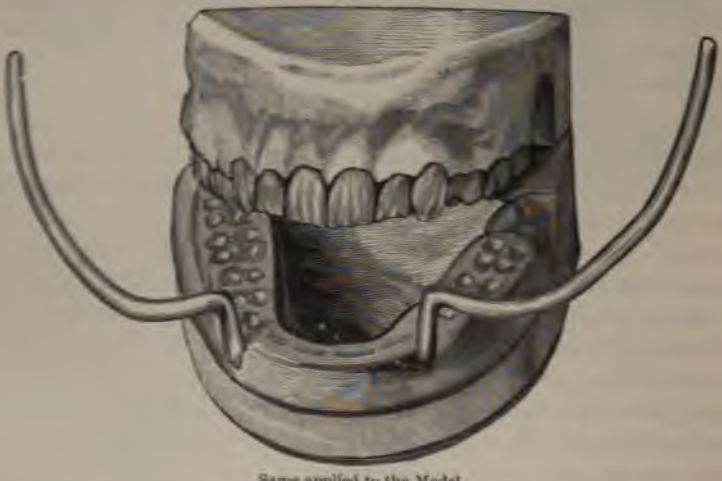
If teeth are only loosened at the point of fracture they should be permitted to remain; but if they are much displaced it is better to remove them entirely. If portions of the alveolar sockets are broken, but their attachments to the soft parts are not much disturbed, they should also be replaced, since in many cases they will under these circumstances become reunited.

Fig. 63.



Kingsley's Apparatus.

Fig. 64.



Same applied to the Model.

During the progress of the treatment the patient must be nourished with beef-tea and other liquid food; he must not be permitted to lie upon either side of his face; the mouth may be washed several times daily with a weak solution of tincture of myrrh in water; and, if it is thought necessary, the surgeon need not hesitate in most cases, once or twice a week, to remove the dressings, including the interdental splint in case it is employed, and cleanse the mouth thoroughly. Of course this should be done with care, so as to disturb the fracture as little as possible.

Union is accomplished in from two to four weeks, with but rare exceptions, and in most examples of simple fracture little or no permanent deformity remains.

Fractures at or near the symphysis are usually accompanied with only a slight vertical displacement and require no special consideration.

Fractures at the angle, involving the sockets of the last molars, though the fragments are not generally much displaced, frequently demand the prompt extraction of one of the molar teeth, on account of the difficulty of closing the mouth when the tooth is only slightly loosened and elevated; abscesses are very prone to result from these fractures. Occasionally it is found that the lateral pressure of the sling or bandage forces the fragments inwards, and in such cases it may be necessary to place under the chin a firm wooden or gutta-percha splint, with expanded extremities which will allow the sling to support the chin without making lateral pressure.

Fractures of the ascending rami and condyles, when properly adjusted, require generally no other apparatus than a sling to secure immobility. Cases have been reported, however, in which the tendency on the part of the lower fragment to become displaced backwards has only been overcome by wires attached at one extremity to one of the lower back teeth, and at the other to the corresponding front upper cuspid.

In case the coronoid process is broken, it will probably be quite as well not to make any surgical interference. We possess no means of adjustment except to close the mouth, and there is no reason to suppose that a displacement, resulting in a fibrous union, would render the jaw any less useful than it was before.

Fractures of the Os Hyoides.

This bone has been broken either in its body or through one of the cornua, by hanging, by the grasp of the hand, by a fall upon the neck, and by muscular action alone, as in throwing the head violently backwards. The fracture is characterized especially by displacement, difficulty of deglutition, and sometimes by difficulty in respiration. Reduction has been accomplished by introducing the finger into the pharynx; in most cases, however, although replaced, the fragments would not remain in position. The head should in general be kept well thrown back; and if great pain is experienced in deglutition, the patient may be fed through a stomach-tube.

The accident is not in itself generally fatal. Of the eleven cases which I have found recorded, six have recovered. Among the cases which recovered, three of the fractures had been caused by grasping the throat, and one was caused by muscular action.

Fractures of the Larynx and Trachea.

In a record of sixty-two cases collected by A. Poinsot, twenty-four were fractures of the thyroid cartilage alone and of these eighteen died; and of the remaining thirty-eight examples all died but six.[1] They have been caused by hanging, by grasping the neck, by falls or other direct blows. I have seen one case of fracture of the larynx caused by the kick of a horse.

If the patient is threatened with suffocation, tracheotomy is the only proper alternative; but my own patient, upon whom I performed laryngotomy on the second day, died. In a record of eight cases collected by Dr. Hunt, of Philadelphia, upon whom tracheotomy was performed, six recovered. It may be proper also to introduce a tube into the stomach to supply the patient with food.

Fractures of the True Vertebræ, and Rupture of the Intervertebral Cartilages.

The vertebræ may be broken through any one of their several processes, through the vertebral arches, or through their bodies. The intervertebral substance may also be torn asunder. Fractures of the arches, of the bodies, and rupture of the intervertebral substance are the most common, and it is these latter alone which in themselves are competent to cause pressure upon the spinal marrow.

Fractures of the bodies of the vertebræ have been observed to occur most often in those portions of the spinal column which have the greatest latitude of flexion and extension, namely, between the third and seventh cervical, between the eleventh dorsal and second lumbar, and between the fourth lumbar and the sacrum.

The signs of a fracture are crepitus, displacement, and paralysis. Crepitus if present must be conclusive, but it is generally absent; or rather it would, in most cases, be very unwarrantable to attempt to produce it; nor would it be occasioned by motion in examples of fracture of the intervertebral cartilages. Displacement, also, does not always exist in a degree to be discovered before death; and paralysis may be due to concussion, extravasation, or inflammation, as well as to a fracture with displacement.

It follows, therefore, that a fracture cannot always be positively diagnosticated. I have lately seen a rupture of one of the intervertebral cartilages of the cervical vertebræ resulting in death, in which the autopsy disclosed no displacement, nor could crepitus be produced by motion of the vertebræ upon each other.

If, in a recent accident, paralysis dates from the moment of the receipt of the injury, there being no displacement or crepitus, we may conclude that it is either an example of concussion, or of fracture in which displacement has occurred to an extent sufficient to lacerate or contuse the spinal cord, but the fragments have spontaneously resumed their places. The possibility of the condition named in the last supposition is confirmed by a case which came under my own observation.

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[1] Poinsot, French ed. of my Treatise on Fractures and Dislocations, and seventh American ed.

If the paralysis, commencing at the moment of the receipt of injury, continues after the lapse of several days, we may in most cases exclude concussion, and very properly decide that the symptoms are due to a fracture, with either a temporary or permanent displacement. Yet I have seen one fatal case in which a fracture existed in the upper cervical region without displacement, with no appreciable lesion of the cord beyond a slight degree of softening, and which softening seemed to be due alone to the concussion — or, more properly speaking, to the inflammatory reaction resulting from concussion. This patient had paralysis from the moment of injury until his death, which took place on the eleventh day. It is possible, therefore, that the paralysis from concussion alone may continue until death. Other writers have confirmed this observation.

Fortunately, since the differential diagnosis between concussion of the spine and a fracture with no appreciable displacement is sometimes difficult, an error in this regard does not usually compromise the safety or good of the patient, inasmuch as the same plan of treatment will be proper in either case. It is only the prognosis which is thereby rendered uncertain.

Cases are not unfrequent, also, in which the occurrence of paralysis after the lapse of several hours, furnishes presumptive evidence of extravasation of blood; and the autopsy has occasionally sustained the presumption. In still other cases paralysis delayed for a longer period has been proven to be due to inflammation of the meninges, with consequent effusions.

The fact that a spinous process may be broken without implicating any other portion of the vertebra, must not be forgotten when examining the spine for displacement.

It is scarcely necessary to say that the paralysis will affect the body and its extremities more or less, in proportion as the injury is higher or lower in the vertebral column. Several examples have been reported of fracture below the second lumbar vertebra unaccompanied with paralysis. If the fracture occurs in the dorsal vertebra, at any point below the origin of the brachial plexus, the paralysis does not include the upper extremities. If the third or fourth cervical vertebra is broken, the upper extremities are also paralyzed. A fracture with displacement, above the second or third cervical vertebra, involves the origins of the phrenic nerves, and death takes place in most cases immediately.

Treatment.—Dr. Ashhurst has tabulated 38 examples of resection of the spine, made for the relief of pressure upon the marrow caused by fracture and depression of vertebræ. One or two of these are of doubt ful authenticity. The result is said to be known in 34 cases; and of these 29 died. In the remaining 5 cases which are believed to have survived the operation some considerable time, not one was relieved of the paralysis.

Such results are by no means encouraging, and would scarcely warrant any future attempts in this direction. Of one thing we feel assured: resection offers little or no chance of success in those examples in which the paralysis is due to fracture with displacement of the bodies of the vertebræ. Only when the arches alone are broken and have been driven in upon the cord, can any hope be entertained that elevation or removal of the fragments will give relief; and the extreme difficulty of making an accurate diagnosis, such as will exclude a fracture also of the bodies of the vertebræ, must continue to render a resort to the knife an expedient of doubtful propriety.

The first and most important requisite of successful treatment in a majority of these cases is a water-bed, since without this bed-sores are almost inevitable if life is prolonged a few weeks. I have in a few cases of late, when the fracture was below the middle of the dorsal region, employed with advantage moderate extension by means of a pulley and weight; the extension being applied to the lower extremities in the same manner as in fractures of the femur. In case this plan is adopted, the bandages employed to make fast the adhesive plasters must not be applied very tight, lest they should cause œdema or excoriations of the limbs; and the weight must be light, not exceeding eight or ten pounds for an adult. In two examples, also, of fracture of the cervical vertebræ, my patients have experienced great relief from extension in the opposite direction, by means of straps fastened underneath the chin and occiput. Perfect quietude must be enjoined, and for this reason it is very improper in the early period to administer cathartics. The urine should be drawn at least twice daily.

After the period of inflammation is fully past, if paralysis still remains, especial attention should be paid to the regulation of the bowels, and strychnia should be administered, in doses varying from the one-twentieth to the one-eighth of a grain, three times daily. Electricity, friction, and passive motion are also valuable adjuvants in restoring sensation and muscular contractility.

Fractures of the Sternum.

The sternum is generally broken by external violence. It is said, however, to have been broken by muscular action alone. The fracture is generally transverse, and takes place usually at one of the several points where the ribs unite with the sternum; or, in other words, through the line of union of the original six pieces of which the sternum is in early life composed. The manubrium and gladiolus are especially liable to become separated; and in some cases it is observed that in consequence of the absence of a bony union between these portions of the breast-bone, the accident is of the nature of a dislocation or of a diastasis. A few examples of longitudinal fractures have been recorded; and in the case of severe crushing accidents the bone is sometimes comminuted, the lines of separation extending in various directions. Comminuted fractures are usually complicated by severe injuries of the thoracic viscera, and if life is sufficiently prolonged they are not unfrequently followed by mediastinal abscesses. In most cases of transverse fracture the lower fragment advances upon the upper, or it may be found slightly overlapping.

Treatment.—Ordinarily, when the fracture is simply transverse, a full inspiration, the shoulders being at the same time drawn forcibly backwards, will effect a replacement. Adjustment is most easily maintained by a thoracic bandage and compress, while the patient occupies the sitting posture. A failure to maintain complete adjustment is not, however, usually followed by any serious consequences.

Fractures of the Ribs, or of their Cartilages.

Neither the ribs nor their cartilages are often broken in early life; in advanced life both accidents are comparatively frequent. They may be broken by direct blows, counter-strokes, or by muscular action.

In most cases the displacement is very slight; and such displacement as exists cannot be easily overcome; nor is it of much importance that it should be. They unite very quickly, even when it is impossible to secure perfect quietude.

Fractures of the cartilages unite by bone, as has been already explained when speaking of fractures of the cartilages in general.

In order to restrain the action of the ribs, the thorax should be enclosed with a broad band, or with successive turns of a roller; but if, as sometimes happens, the bandage increases the pain, it should be omitted. It may be necessary to employ opiates in moderate doses to lessen the acuteness of the pain.

If the fracture is compound and comminuted, the small fragments should be removed with a pair of forceps, or at least raised sufficiently to prevent their projection toward the pleural cavity.

It is seldom, even in gunshot fractures, that the intercostal artery bleeds sufficiently to require a ligature; but in case the hæmorrhage from this source is alarming, and the artery cannot be tied in the usual way, or its bleeding be arrested by digital compression, it will be proper to cast a ligature around the entire rib on the side of the fracture nearest the spine, or even, in some cases, to exsect a portion of the rib in order to reach and secure the bleeding vessel.

A moderate emphysema is quite common in connection with both simple and compound fractures of the ribs, and generally demands no special attention, since in most cases it disappears spontaneously in two or three weeks. In case it becomes very extensive it may be necessary to make an incision, or to open the wound down to the point of fracture, in order that the air may escape freely from within outwards.

Fractures of the Clavicle.

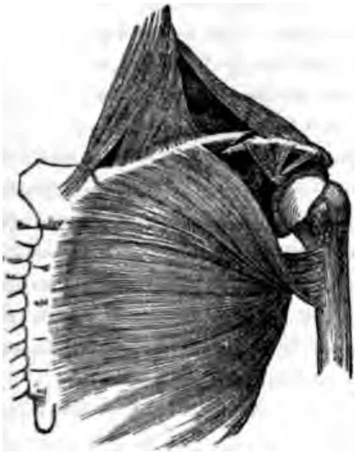
The clavicle is only very rarely broken near its sternal extremity. In most of the cases of fracture at this point which I have seen, the displacement has been slight and a good union has been easily obtained. Fractures near the acromial end are somewhat more common; and in these cases the outer fragment falls a little, but the broken ends do not overlap, so that it is not found very difficult to secure a good result. In children the fracture of the clavicle is most often incomplete, and takes place usually near the middle of the bone; and in these cases, also, it is usually sufficient to support the arm in a sling, and, with a few turns of a roller, to secure the elbow to the side of the body. If in the treatment of these latter accidents it is found impossible at first to restore the bone completely to line, it happens eventually, as I have already explained when speaking of partial fractures, that a slow and spontaneous restoration takes place.

In a vast majority of the cases of fracture of the clavicle in adults, the bone gives way near the junction of the outer and middle thirds; and in these cases the fracture is generally quite oblique. This is the typical fracture of the clavicle, and the one which has hitherto given the surgeon so much trouble. The clavicle is, of all the long bones, that which is the most exposed to observation, both by its position and by the small amount of its external covering. Surgeons have therefore been more desirous to obtain a perfect result in the case of this bone than of any other. There are many reasons, however, why a failure might reasonably be expected. The fracture is almost uniformly very oblique; the bone is much curved and very slender; no adequate side supports can be applied; the muscles which cause the displacement act generally at a considerable angle with the axis of the bone; they are, moreover, large and powerful, and whatever means we employ to oppose their action must inevitably bear more or less upon the axillary vessels and nerves.

We have to add, that no form of apparatus ever yet devised has been able to overcome these difficulties completely and for a sufficient length of time to insure a perfect union; and that if we are fortunate enough to have, now and then, a perfect result, it has been because all these difficulties did not happen to be present in those cases; and considering the great amount of inventive skill which has been expended upon this subject, and the infinite variety of plans which have been suggested and practised, we ought to entertain very little hope of future progress in this direction.

Let us see, however, what may be accomplished, or what is to be the result of a complete failure.

Fig. 65.



Complete fracture of the clavicle at junction of outer third with inner two-thirds. The most frequent point of fracture.

When the clavicle is broken and completely separated at that point which has already been stated to be the usual seat of fracture in the adult, namely, at the junction of the outer and middle thirds, the shoulder falls downwards and a little forwards, and is at the same time drawn strongly towards the side of the body. The outer end of the sternal fragment is also more or less lifted by the action of the sterno-cleido-mastoid muscle. The inner fragment generally lies above or in front of the outer fragment, overlapping the latter, half an inch or more, but in contact with it.

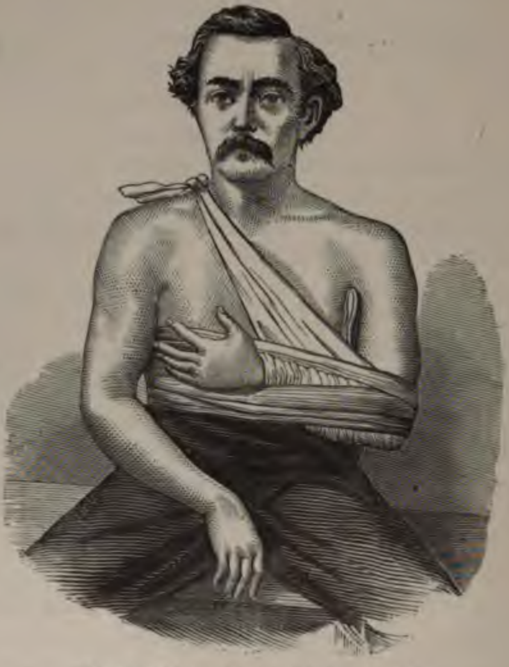
A sling, in any of the various modifications which have been employed, will lift the shoulder, and thus accomplish the first indication of treatment.

The forward displacement, depending chiefly upon the powerful and preponderating action of the pectoralis major and minor, is seldom very noticeable, and, if permitted to remain, would hardly be regarded in itself as a deformity; but it increases the overlapping, and, if it were possible to do so, ought to be remedied. The truth is, however, that, so far as my experience goes, no plans of treatment which permit the patient to walk or sit, are able to overcome the tendency of the shoulder to fall in this direction. If for a moment, or for a few hours, they have seemed to hold the shoulders well back, they have uniformly failed to maintain them in this position after the lapse of a day or two.. It is only, then, by placing the patient upon his back, upon a hard mattress, that the indication can be completely fulfilled; in which position the weight of the shoulders will aid in the restoration, while at the same time the angle of the scapula, in contact with the mattress, is pressed forwards against the back of the chest, and the glenoid cavity with the head of the humerus is tilted backwards.

The overlapping or the displacement in the direction of the axis of the bone is the remaining source of deformity, and gives rise to the remaining indication of treatment, namely, to carry the shoulder directly outwards, or away from the body; and this is what surgeons have hitherto found it impossible to do, either by posture or mechanical contrivance, except in rare cases. It is true, however, that many broken clavicles unite without any actual deformity under my own management, and under the management of other surgeons, but these cases were not the typical fractures which we are now considering. It is equally true, also, that in the case of the typical fracture here referred to, a union is often accomplished without any apparent overlapping or other deformity, for the reason sometimes that the amount of fat covering the clavicle prevents its observation, or the fragments, if overlapped, do not project toward the skin, and in such cases nothing but a very careful measurement would determine the existence of displacement.

The final result, then, of our best efforts is that the shoulder is restored to its original height, perhaps a little inclined forwards; the fragments overlap about half an inch, presenting more or less deformity, according to the position of the fragments and the obesity of the patient; and in this position they unite speedily, giving to the patient an arm as useful as before. In men this overlapping is a matter of no consequence, except when the suspender, or the belt worn by the soldier, chafes upon the projecting angle.

Fig. 66.



The author's Dressing for a Broken Clavicle.

Paralysis of the arm has sometimes resulted; but it was either due to an original injury of some portion of the brachial plexus, or to the improper use of an axillary pad.

In reference to the multitude of forms of apparatus which have been employed, I shall content myself by saying that the figure-of eight is inefficient; the cross is almost equally inefficient, difficult to maintain in position, and cumbrous; all the various methods of making counter-extension in the axilla, including the axillary pad, are, as I have before stated, inadequate to the accomplishment of their purpose, and dangerous; the *apparatus immobile* is oppressive; adhesive plasters applied in any manner about the chest soon loosen; and, in short, not one of these plans offers any advantages to compensate for their inconveniences.

The method, then, which attains all that has up to this moment been attained by any other, and is at the same time both simple and safe, is, first, a sling passed under the elbow of the broken limb, and tied upon the opposite shoulder; second, an axillary pad which completely fills the space between the upper part of the arm and the side of the chest, but which is not so thick or firm as to constitute a fulcrum; third, a bandage to secure the elbow against the side of the body.

If, in addition, the patient be laid on his back upon a firm bed, with his head supported by a pillow, and is not allowed to rise or to move, there will be in the end no perceptible deformity from the forward displacement of the shoulders; but, inasmuch as many patients cannot endure confinement upon their backs in bed, and to most patients it would prove exceedingly irksome, and especially since the advantages to be gained thereby are inconsiderable, I have not thought it worth while, except in a few cases occurring in hospital practice, to adopt this plan of treatment.

Fractures of the Scapula.

When the body of the scapula is broken, the fragments should be put at rest by placing the forearm in a sling, and securing the arm to the body by a few turns of a roller. Fractures of the acromion process outside of the junction of the clavicle with the scapula, require no treatment. Fractures of this process through the acromio-clavicular articulation, or posterior to this point, are to be treated in the same manner as fractures of the clavicle. Fractures of the coracoid process may be treated by placing the hand over the upper portion of the opposite thoracic wall, and securing the arm, forearm, and hand in this position by a roller.

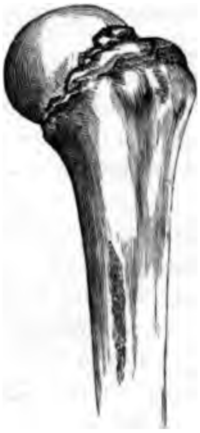
Fractures of the surgical neck of the scapula through the semilunar notch, carrying away at the same time the coracoid process and the glenoid cavity, will be recognized by grasping the scapula with one hand, while the head of the humerus is moved with the other. The treatment, after reduction, consists in placing a pad in the axilla, and securing the arm to the side of the body by a roller.

All of the fractures mentioned are rare, but a fracture of the body is more frequent than either of the others.

Fractures of the Humerus.

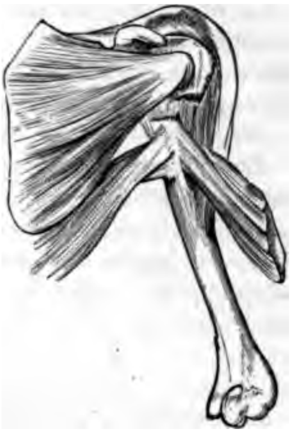
Fractures at the anatomical neck, separating the head from the tuberosities, and fractures of the greater and lesser tuberosities, are of rare occurrence. They are in most cases the results of direct blows, and they are not usually accompanied with much displacement. Impacted fractures, both intra and extra capsular, are also unfrequent. The surgical neck of the humerus is, however, the frequent seat of fracture, especially in old people ; and in this case it is often broken by so slight a force that the fragments do not become displaced; but in general the lower fragment is drawn up in front, toward the coracoid process, where it is often mistaken for the head of the humerus. In children we occasionally meet with epiphyseal separations which resemble fractures of the surgical neck.

Fig. 67.



Fracture of the Anatomical Neck of the Humerus.

Fig. 68.



Fracture of the Surgical Neck of the Humerus.

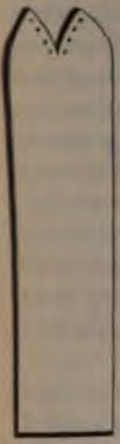
Fractures of the shaft near its middle are generally quite oblique; and if the fracture is just above the insertion of the deltoid, the lower fragment is apt to penetrate the soft parts, in consequence of the violent muscular contraction caused by the sharp points of the bone.

When the humerus breaks near its lower end, the lower fragment is drawn upwards and backwards by the triceps.

Fractures of either the inner or outer condyle are common in children. The fragments are not generally much displaced unless the fracture is complicated with a dislocation.

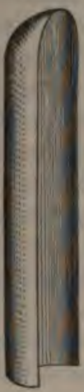
Treatment.—All fractures of this bone, except those at or near the elbow-joint, may be treated upon the same plan. It is almost or quite impossible to maintain extension by apparatus, for the reason that the axilla does not furnish an adequate or safe point of resistance for the counter-extension. A slight overlapping may, therefore, be generally anticipated, but it is not usually such as to be recognized except by careful measurement, and occasions no maiming.

Fig. 69.



Pattern of Long Splint for Fractures of Humerus.

Fig. 70.

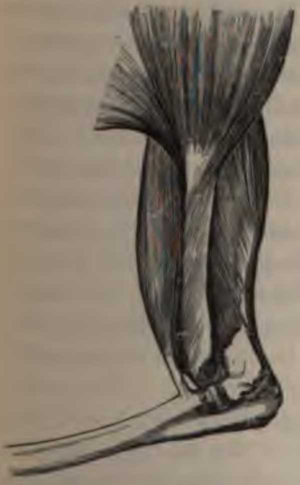


Same, complete.

The fragments being reduced as well as possible, a splint, made of leather, felt, or gum-shellac cloth, long enough to extend from above the acromion process to the elbow-joint, must be applied to the outside of the arm, enclosing about one-half of the circumference of the limb. This should be moulded and allowed to become dry and hard before it is secured to the arm. A second short splint should be laid on the inside of the arm; both of these splints, carefully padded and covered with a sack of woollen cloth, are then to be made fast to the arm by a roller; and finally, the forearm being flexed upon the arm and suspended by a sling passing under the wrist, the arm must be secured to the side of the body by a separate roller.

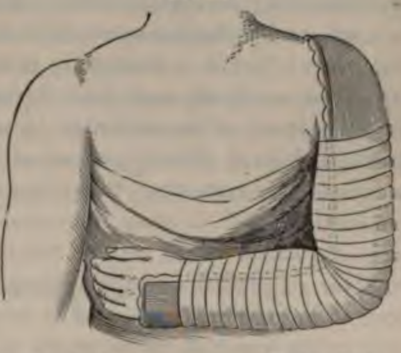
I do not find it necessary to apply a bandage to the forearm in these cases. Its omission does not usually result in œdema of the limb below the elbow-joint, unless the roller enclosing the arm-splints is unnecessarily tight; and in case it does occur when the roller is properly applied, a few days' rest in the recumbent posture is the most convenient remedy.

Fig. 71.



Fracture just above the Condyles.

Fig. 72.



Dressing for Fractures at or near the Elbow-Joint.

Fractures at or near the elbow-joint are more difficult of management and exact great care and attention on the part of the surgeon. The forearm should be placed at a right angle with the humerus and maintained in this position by a right-angled splint.

After a thorough trial of angular splints made with movable joints, of wood, pasteboard, and various other kinds of apparatus, I am convinced that a thick piece of gutta-percha, moulded to the back and sides of the arm, elbow, and forearm, will give the most satisfaction. When it can be obtained, an angular splint of hard felt, previously moulded upon a model, will answer nearly as well. Sole-leather, if used, must be cut at right angles and applied to each side of the limb, since it cannot be made to double smoothly over the elbow upon its posterior aspect when bent at a right angle; but splints applied to the sides of the limb are not managed so easily as when applied to the back; and they are particularly inconvenient when laid upon the front, where most of the swelling usually takes place.

The gutta-percha or felt splint, covered with a woollen or cotton sack, is first secured to the forearm by a roller; and then, in a case of fracture of the humerus above the condyles, while extension is made, the upper portion of the splint is secured to the arm in a similar manner. The front or bend of the elbow should always be well covered with cotton batting before enclosing the elbow-joint in the turns of the roller.

In addition to the danger of deformity from displacement in these fractures, there is added the danger of anchylosis; to avoid this latter the limb must be removed carefully from the splint as soon as the swelling has in some measure subsided—perhaps as early as the tenth or fourteenth day—and gently flexed and extended before replacing the splint. If the fragments are not found to be disturbed by this motion, the same may be repeated daily until the cure is accomplished. This is a safe and judicious measure in most fractures near to but not involving joints; but it is eminently necessary in fractures of the condyles, which, in nearly all cases, have been found to implicate more or less the joint surfaces or the articular ligaments. In these cases the displacement, as I have already remarked, is generally trivial; nor is it usually increased by removing the splints and flexing or extending the limb moderately. If it were increased, it must be understood that anchylosis is a much more serious result than displacement. I have seen a condyle displaced a little without perceptible deformity, and I have seen complete non-union of a condyle without the slightest imperfection in the motions or strength of the limb. It has, therefore, often presented itself as a serious question, whether we would not do better, in most of these cases of broken condyles, if we never employed a splint at any period of the treatment.

The lower epiphysis is occasionally separated in children, but so rarely that I have never met with this accident in my own practice. In case it were to occur, the treatment would be the same as for a fracture occurring in the region of the elbow.

Non-union occurs more frequently in the case of the humerus than in the case of any other long bone in the body, excepting the femur when broken within its capsule. I believe the explanation of this fact is to be found in the peculiar motion to which the fragments are subjected during treatment,—a motion of the fragments to and from each other —the effect of which I have fully stated in my general remarks on the causes of delayed union. The forearm being placed at a right angle with the arm, either with or without a splint to retain it in this position, soon becomes stiff, or partially anchylosed at the elbow-joint; when this has occurred, whatever motion is inflicted upon the forearm is conveyed directly to the point of fracture, and, as the elbow is held at a fixed point by the splint or sling, the upper end of the lower fragment will be carried forwards and backwards.

I have therefore been able in several instances to hasten consolidation in cases of delayed union, by putting the arm and forearm in a straight position beside the body and then applying a splint long enough to extend from the shoulder to the hand. When this is done, whatever motion occurs at the point of fracture will be a motion upon this point as upon a pivot, which is much less apt to prevent union; or there may be no motion at all except what occurs in the shoulder-joint.

Other reasons have been assigned for the frequency of non-union, or of ligamentous union in this bone, but none of them have seemed satisfactory; while experience has furnished me some very substantial evidence of the correctness of the theory which I now offer.

In case this bone refuses finally to unite, we ought to attempt to bring about union, first, by perforation, as has been explained in the section on delayed and non-union; but I have succeeded most often here by resection—that is, by exposing the point of fracture, sawing or cutting off the ends of the bones, and then securing them firmly in contact by stout iron or silver wire. As a splint to support the arm and maintain perfect quietude after this operation, I consider gutta-percha indispensable. It must enclose the limb from the shoulder to the hand. The wire will sometimes escape spontaneously. If it does not, it should be allowed to remain at least four or six months after the consolidation is effected.

Fractures of the Radius.

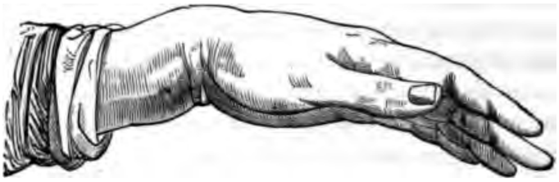
The radius alone is seldom broken except near its lower end. Occasionally, however, this accident occurs in its middle portion, and still more rarely near its head.

A fracture anywhere in the middle portion is easily recognized; and is to be treated in the same manner as will hereafter be directed for a fracture of both radius and ulna.

A fracture of the neck above the tubercle may be mistaken for a dislocation of the head of the radius forwards, since the lower fragment will be drawn forwards by the action of the biceps. It will be mos easily replaced while the forearm is flexed upon the arm; and it mus be retained in place by a right-angled splint applied to the back of th arm and forearm, and by a compress placed a little below the insertio of the biceps and held in position by a roller.

Colles' Fracture.—The fracture immediately above the lower en of the radius, generally known as Colles' fracture, has been the subjec of much study, but surgeons are not yet fully agreed as to its precise character. It is the result, usually, of a fall upon the palm of the hand, and is characterized by the usual signs of fracture, and by a deformity in which some writers have detected a resemblance to a silver fork. The lower fragment, including the carpal bones, is tilted backwards, the hand inclines a little to the radial side, and the fingers are in general slightly flexed.

Fig. 73.

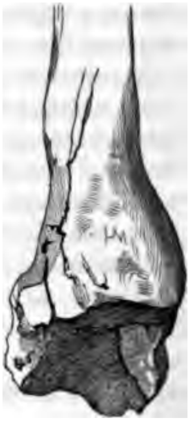


Colles' Fracture.

The point at which the fracture occurs is usually from half an inch to one inch above the lower end of the bone.

According to Vollemier the fracture is generally transverse, both in its antero-posterior and lateral direction. Robert Smith has noticed that the lower fragment is in most cases simply tilted backwards, the broken ends not being completely displaced from each other; there is usually little or no impaction, nor is the upper end of the lower fragment drawn towards the ulna by the pronator quadratus, as has been generally believed, but the lower end of the lower fragment is thrown backwards, with little or no displacement at the point of fracture.

Fig. 74.



Comminuted Fracture of the lower end of the Radius.

Others maintain that in addition to this general displacement of the lower fragment, it generally suffers a comminution.

Prof. Moore, of Rochester, believes that in most cases there is added a true luxation of the lower end of the ulna; and that the chief obstacle to the reduction is the entanglement of the ulna in the annular ligament.

It is my belief that in a majority of cases there is only a tilting backwards of the lower fragment; that in a minority of examples the lower fragment is comminuted; that in a few cases it is impacted, with or without comminution; and that it happens now and then, yet very seldom indeed, that the lower fragment is completely displaced backwards, so that the broken ends no longer rest upon each other. There can be no question, also, that the peculiar form of displacement or dislocation of the lower end of the ulna, in which the ulna becomes caught and detained under the annular ligament, constitutes in a few cases the chief obstacle to reduction, especially when the accident has been occasioned by a fall from a great height and unusual force has been applied against the palm of the hand.

In addition to the fracture there is associated, in probably every case, a stretching of the ligaments about the joint, or what is usually denominated a sprain; especially is the radio-ulnar ligament apt to suffer laceration, and occasionally, also, the styloid process of the ulna is broken.

Reduction is accomplished in most cases with ease by simply pressing the lower fragment forcibly forwards. If, however, complete displacement exists, or if there is impaction, it will be requisite to employ extension. If the ulna is displaced and caught in the annular ligament, extension with circumduction will facilitate the restoration of both the radius and ulna to position.

A very common result of treatment in Colles' fracture is, that the hand remains slightly deflected to the radial side, and the carpus, including the lower fragment, inclines a little backwards. So far as the falling of the hand to the radial side is concerned, I am confident that it is often due to the rupture of the radio-ulnar ligament, which allows the lower end of the ulna to project to the ulnar side. Imperfect restoration of the lower fragment to its original position is responsible for the remainder of the deformity; yet the utmost skill and attention cannot always prevent its occurrence.

Another result, which is much the most serious, but which has hitherto received too little attention, is prolonged and sometimes permanent stiffness of the joint.

In the treatment of this fracture the following indications are most prominent: first, to reduce the fracture; second, to maintain the lower fragment in position by pressure applied to its posterior or dorsal surface; third, to allow to the wrist-joint, throughout the whole of the treatment, as much motion as is consistent with the retention of the fragments in place.

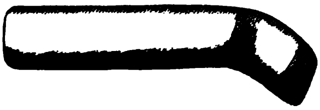
The manner of reducing the fracture has already been stated. The pressure required to maintain the fragment in place will be best applied to the dorsal surface of the lower fragment by a firm dorsal splint, constructed from the lid of a cigar-box, or from a shingle of the width of the widest part of the forearm, and long enough to extend from the elbow

to the middle of the carpus. This splint should be enclosed in a cotton or flannel sack, and partially filled, on the side of the splint which is to lie against the arm, with cotton batting, and before closing the ends of the sack a portion of the cotton batting should be massed at the lower end of the splint so as to form a heavy pad. This single splint, thus constructed, will in most cases answer the second indication as completely as it can be answered by any other method. Generally, however, I advise the addition of a second or palmar splint, for the reason that two splints are more easily kept in place than one. They give to each other mutual support.

The palmar splint may be formed of the same materials, prepared in the same manner as the dorsal, and of sufficient length to extend from the bend of the elbow, when the forearm is flexed at a right angle, to the middle of the carpal bones; but in the case of the palmar splint the cotton wadding must be crowded away instead of being massed opposite the lower fragment. These two splints are now to be secured in place by a few turns of a roller, and the forearm suspended in a sling.

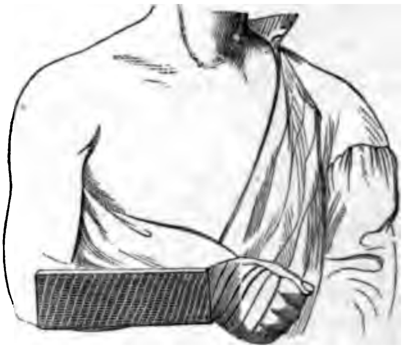
This is essentially the method now almost universally practised by the surgeons of Bellevue Hospital. No one here thinks of using any of the forms of the pistol-shaped splint, so much extolled upon certain theoretical grounds by various surgeons both at home and abroad. The indication of treatment for which it is especially claimed to be useful does not often exist, namely, impaction or overlapping; and, when it does exist, this splint is totally inadequate to accomplish the end proposed.

Fig. 75.



The author's Pistol-shaped Splint for Colles' Fracture.

Fig. 76.



Dressing applied for a Colles' Fracture. (Sling omitted.)

If the surgeon for any reason, however, chooses to employ it, he will have only to extend his palmar splint obliquely from the wrist to the metacarpo-phalangeal articulation, padding it carefully in the palm of the hand to fit the various irregularities of surface, as shown in the accompanying illustration. In the illustration, intended to represent the dressing applied and complete, the sling is omitted, for the purpose

of showing with more precision the form and extent of the dorsal splint.

The third indication, namely, to prevent anchylosis, is to be accomplished by moving the joint daily, or at least from a very early period, until the cure is completed. In case the palmar splint is extended to the metacarpo-phalangeal articulation, the portion of the bandage which confines the hand will have to be removed temporarily in order to give motion to the wrist-joint.

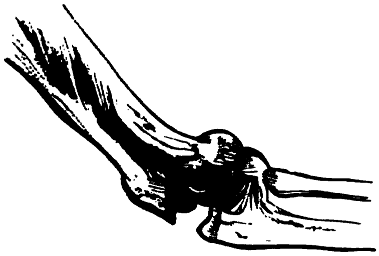
As first taught by Barton, a fracture of the lower end of the radius sometimes takes place in which the posterior lip only of the radius is broken off; the signs of which accident are very much like those of a Colles' fracture. If it does occur, the treatment will be the same as for a Colles' fracture.

Fractures of the Ulna.

Fractures of the **Olecranon Process of the Ulna** are generally occasioned by direct blows, such as a fall upon the elbow. Malgaigne thought it was sometimes broken by muscular action alone.

In several cases that have come under my notice, the fragments were only slightly separated from each other, so that crepitus was easily produced; but generally the process is drawn more or less forcibly from the shaft by the action of the triceps. It is probable that differences in this regard are due to the less or greater laceration of the aponeurotic expansion of the triceps, of the ligaments, and of the capsule.

Fig. 77.



Fracture of the Olecranon Process.

Although the displacement may be inconsiderable, the fragments unite almost constantly by ligament. If the ligament does not exceed half an inch in length, the ability to extend the arm is not sensibly diminished, unless, indeed, some anchylosis shall have taken place.

In treating this fracture, the forearm should be made straight upon the arm, so as to relax the triceps; and the upper fragment must be retained in place by a roller applied obliquely across the back and front of the arm, while the straight position is maintained by a splint. Duverney, Desault, Sir Astley Cooper, Boyer, and indeed most surgeons, recommend that this bandage or roller shall be applied directly to the limb in its whole circumference, and that the splint shall be placed above the bandage. This method has no advantages, and is objectionable as increasing the danger of strangulating the limb.

My own mode of dressing is as follows: A light wooden, or gum-shellac cloth splint is constructed, long enough to extend from about

to the middle of the carpus. This splint should be enclosed in a cotton or flannel sack, and partially filled, on the side of the splint which is to lie against the arm, with cotton batting, and before closing the ends of the sack a portion of the cotton batting should be massed at the lower end of the splint so as to form a heavy pad. This single splint, thus constructed, will in most cases answer the second indication as completely as it can be answered by any other method. Generally, however, I advise the addition of a second or palmar splint, for the reason that two splints are more easily kept in place than one. They give to each other mutual support.

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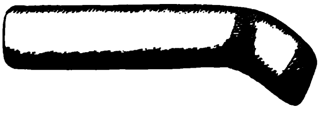
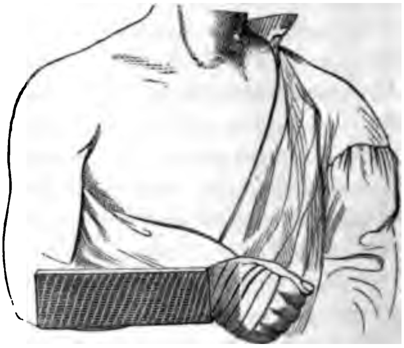
Fig. 75.



The author's Pistol-shaped Splint for Colles' Fracture.

Fig. 76.



Dressing applied for a Colles' Fracture. (Sling omitted.)

If the surgeon for any reason, however, chooses to employ it, he will have only to extend his palmar splint obliquely from the wrist to the metacarpo-phalangeal articulation, padding it carefully in the palm of the hand to fit the various irregularities of surface, as shown in the accompanying illustration. In the illustration, intended to represent the dressing applied and complete, the sling is omitted, for the purpose

of showing with more precision the form and extent of the dorsal splint.

The third indication, namely, to prevent anchylosis, is to be accomplished by moving the joint daily, or at least from a very early period, until the cure is completed. In case the palmar splint is extended to the metacarpo-phalangeal articulation, the portion of the bandage which confines the hand will have to be removed temporarily in order to give motion to the wrist-joint.

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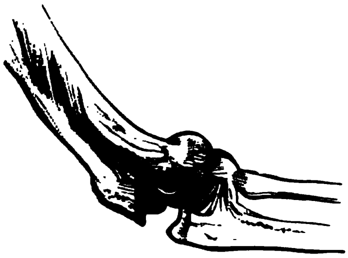
Fractures of the **Olecranon Process of the Ulna** are generally occasioned by direct blows, such as a fall upon the elbow. Malgaigne thought it was sometimes broken by muscular action alone.

In several cases that have come under my notice, the fragments were only slightly separated from each other, so that crepitus was easily produced; but generally the process is drawn more or less forcibly from the shaft by the action of the triceps. It is probable that differences in this regard are due to the less or greater laceration of the aponeurotic expansion of the triceps, of the ligaments, and of the capsule.

Fig. 77.



Fracture of the Olecranon Process.

Although the displacement may be inconsiderable, the fragments unite almost constantly by ligament. If the ligament does not exceed half an inch in length, the ability to extend the arm is not sensibly diminished, unless, indeed, some anchylosis shall have taken place.

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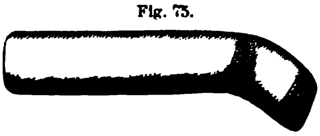
My own mode of dressing is as follows: A light wooden, or gum-shellac cloth splint is constructed, long enough to extend from about

to the middle of the carpus. This splint should be enclosed in a cotton or flannel sack, and partially filled, on the side of the splint which is to lie against the arm, with cotton batting, and before closing the ends of the sack a portion of the cotton batting should be massed at the lower end of the splint so as to form a heavy pad. This single splint, thus constructed, will in most cases answer the second indication as completely as it can be answered by any other method. Generally, however, I advise the addition of a second or palmar splint, for the reason that two splints are more easily kept in place than one. They give to each other mutual support.

The palmar splint may be formed of the same materials, prepared in the same manner as the dorsal, and of sufficient length to extend from the bend of the elbow, when the forearm is flexed at a right angle to the middle of the carpal bones; but in the case of the palmar splint the cotton wadding must be crowded away instead of being massed opposite the lower fragment. These two splints are now to be secured in place by a few turns of a roller, and the forearm suspended in a sling.

This is essentially the method now almost universally practised by the surgeons of Bellevue Hospital. No one here thinks of using any of the forms of the pistol-shaped splint, so much extolled upon certain theoretical grounds by various surgeons both at home and abroad. The indication of treatment for which it is especially claimed to be useful does not often exist, namely, impaction or overlapping; and, when it does exist, this splint is totally inadequate to accomplish the end proposed.

Fig. 75.



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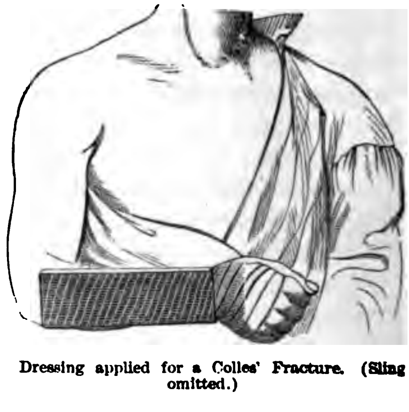

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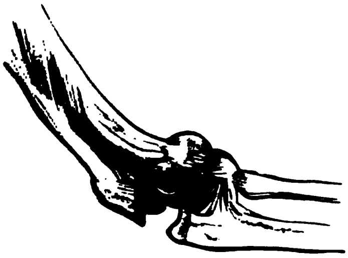

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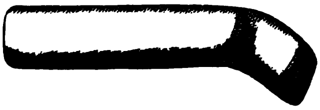

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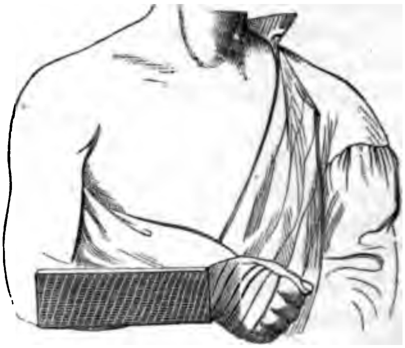

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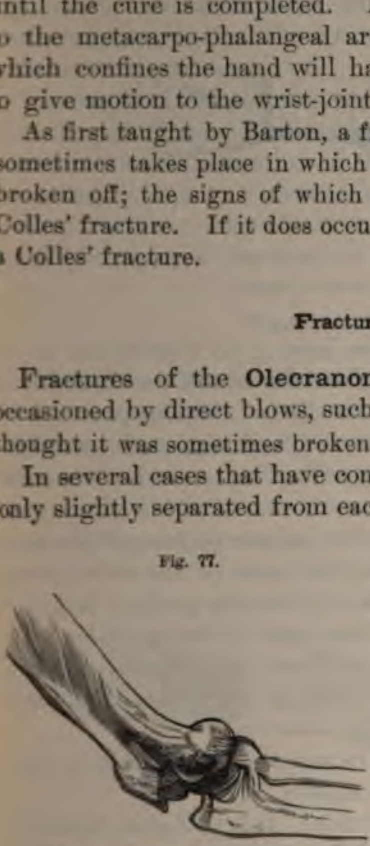

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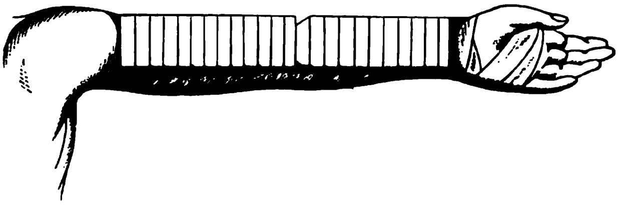
My own mode of dressing is as follows: A light wooden, or gum-shellac cloth splint is constructed, long enough to extend from about

four inches below the shoulder to the wrist, and of the width of the arm in its widest part. At a point about three inches below the olecranon process a notch is made on either side of the splint, to receive the oblique turns of the roller, and prevent them from sliding The splint

Fig. 78.



Dressing for a Fracture of the Olecranon Process.

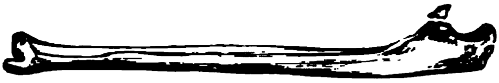
is then covered on one side with cotton batting, so distributed as to meet the irregularities of the limb, and then the whole is enclosed in a cover or sack. It is not desirable that the limb should be placed in a position of forced dorsal extension, but only of easy and moderate extension, and for this purpose the cotton batting must be in excess along the middle portion of the splint.

The splint thus prepared is laid upon the palmar surface of the arm and forearm, and secured by a roller, the first turns of the roller being passed obliquely across the back of the arm above the process, and over the front of the splint through the notches made in its two sides. By this plan the olecranon will be held down and the muscles properly compressed, while the circulation on portions of both sides of the arm will remain unobstructed.

To avoid anchylosis the splint should be removed from time to time, and the elbow-joint subjected to passive motion.

The Coronoid Process is seldom broken. It is probable, however, that it is occasionally, but very rarely, broken in connection with dislocations of the radius and ulna backwards; and still less often from direct blows. Malgaigne and Fergusson thought the accident very frequent, especially in connection with dislocation of the radius and ulna

Fig. 79.



Fracture of the Coronoid Process.

backwards, but my own studies and experience do not sustain this opinion. Those who feel any special interest in the discussion which has originated upon this subject are referred to the seventh edition of my treatise on Fractures and Dislocations.

Liston thought the coronoid process was occasionally pulled off in children, before it became united to the shaft, by the action of the brachialis anticus: but the coronoid process is never an epiphysis; and, moreover, the brachialis anticus is inserted at its base, where its action could have no influence in causing its separation. It is proper, therefore, to conclude, that the fracture or separation never happened in the manner supposed by Liston.

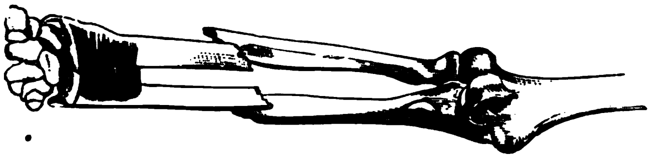
In case of a simple fracture of this process the forearm should be flexed upon the arm in the position of a right angle; and, if it is complicated with a dislocation of the radius and ulna backwards, it should be maintained in this position by a right-angled splint.

Fractures of the **Shaft of the Ulna** alone are to be treated upon the same principles as fractures of the shaft of the radius.

Fractures of the Radius and Ulna.

When **Both Bones of the Forearm** are broken, the diagnosis is very easily made out, and in general the reduction is accomplished without difficulty, but it is by no means certain that their apposition can be accurately maintained. The deformity which I have noticed most frequently after the treatment of this fracture is a lateral deflection, occasioning an angular projection either to the radial or ulnar side.

Fig. 80.



Fractures of Radius and Ulna

The treatment consists in the application of two wooden splints, of the length of the forearm, and of nearly or quite the width of the limb at its widest part, covered and padded as I have directed in the case of a Colles' fracture. These, having been applied to the palmar and dorsal surfaces of the forearm, are to be retained in place by a roller. The forearm is then to be placed in a sling, and suspended in a right-angled position.

The width of the splint recommended in this fracture and in all other fractures of the bones of the forearm, has reference: first, to the avoidance of any lateral pressure, by which the fragments might be made to encroach upon the interosseous space; and, second, to the prevention of ligation of the limb, in consequence of which so many disastrous results have from time to time been recorded. If the bandages do not touch at all, or if they press only lightly upon the radial and ulnar margins, complete strangulation will seldom or never occur.

If, however, a roller, called the primary roller, is applied to the forearm underneath the splints, as was the custom with the older surgeons, and as has been recommended by some surgeons of the present day, the fragments will not only be driven into the interosseous space, but the danger of strangulation will be imminent, no matter what may be the width and form of the splints. Strangulation is also equally liable to occur when leather, felt, pasteboard, or any flexible material is used, which is made to embrace the limb closely, and is then secured in place by a roller.

Why, in the case of the forearm, there is present always a peculiar liability to arrest of circulation by bandages, compresses, and splints, may be readily explained. The radial and ulnar arteries lie very superficially, and repose upon flat surfaces of bone. They are, therefore, easily closed by pressure. It is possible even that this strangulation should take place when splints are employed in the manner which I have directed, and it seems proper to suggest that special care should be taken in all cases, not to make much pressure with the palmar splint near the wrist.

In order that the young surgeon may comprehend the degree of danger which attends the mode of dressing which I have taken such special pains to condemn, it may be necessary to mention that I have seen gangrene of the hand four times from this cause, of which number one died after amputation, and one survived after a spontaneous separation of the arm at the elbow-joint. Many other cases are upon record, and have been especially referred to in my treatise on Fractures and Dislocations. It ought also to be noted that most of these cases occurred in children.

Fractures of the Hand.

Fractures of the Carpal Bones are subject to no special rules of treatment.

The Metacarpal Bones are broken, in most cases, by blows received upon the knuckles in pugilistic encounters. They require for their management a broad, well-padded palmar splint, the fragments being pressed down upon this splint with a compress and roller.

Of fractures of the **Phalanges of the Hand** it is only necessary to say, that no mode of support will be found more convenient than a splint made of gutta-percha, moulded to the palmar surface and underlaid with a piece of patent lint, or of flannel cloth. For this purpose gutta-percha one-eighth of an inch in thickness is most suitable.

Fractures of the Pelvic Bones.

The forms of fracture to which these bones are subject are so varied that classification is almost impossible; nor is there anything in the diagnosis or treatment which would not readily suggest itself to the inexperienced but thoughtful surgeon. The force requisite to fracture them is much greater than is the case with most long bones, consequently their fractures are generally accompanied with some injury of the pelvic viscera, and for this reason especially they often prove fatal. Paralysis of the bladder, and bloody urine, are frequent coincidents; and pelvic abscesses, followed by pyæmia, are not unusual sequents.

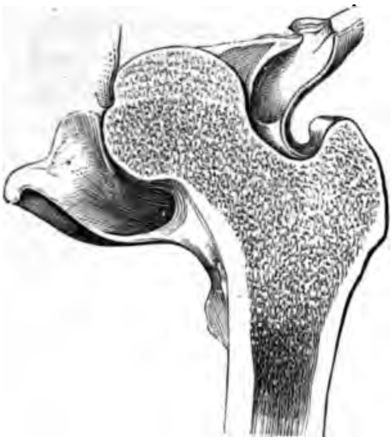
Splints and bandages have little utility in fractures of the pelvic bones, the treatment consisting mainly in rest, and the adoption of such measures as will best control inflammatory action. In many cases a water-bed contributes greatly to the comfort and to the recovery of the patient. The urine may require to be drawn; and deep perineal abscesses may demand prompt and bold incisions.

Fractures of the anterior superior spinous process of the ilium, including sometimes a considerable portion of the corresponding ala, are not unfrequent as a result of direct blows or of crushing accidents. In one example this process was broken off in an old man by muscular action alone. The fragment is found, in most cases, slightly displaced downwards, or downwards and inwards. A restoration may sometimes be effected and maintained by supporting the limb in a flexed position, while the patient rests upon his back.

Fractures of the Femur.

It will be convenient to consider fractures of the femur as occurring through the neck, both within and without the capsule; just below the trochanter minor; in the central portions of the shaft; just above the condyles; through the condyles; and at the points of epiphyseal connections.

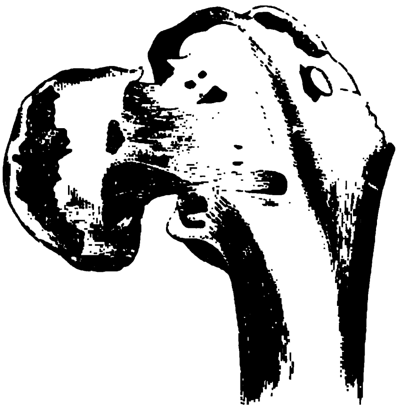
Fig. 81.



Vertical Section of the Neck of a Sound Femur in Middle Life.

Fractures of the Neck of the Femur within the Ca In advanced life the neck of the femur within the capsule u certain changes of form and of structure which predispose it ture. The neck approaches a little more nearly to a right ang

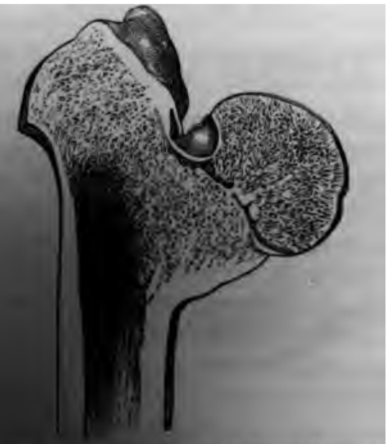
Fig. 82.



Neck of the Femur in Old Age; not broken.

period; the outer or lamellated tissue becomes thinner, and th the cancellous tissue become larger, and are filled with an oily these pathological changes we observe the effects of long-c

Fig. 83.



[illegible] of Chronic Rheumatic Arthritis; not

[illegible] condition of advance [illegible] proportioned to nutrit [illegible] pidly in women than

Age and sex constitute, therefore, predisposing causes of intra-capsular fractures of the neck of the femur.

When the head and neck of the femur are affected with chronic rheumatic arthritis the process of degeneration is still more rapid, and may result in a complete separation of the head from the shaft of the bone, the space made by the removal of the bony tissue being supplied by a dense ligamento-cartilaginous substance, which has sometimes been mistaken for evidence of a fracture.[1]

The direct or mechanical causes are especially the weight or resistance of the body operating at nearly a right angle with the axis of the neck of the femur. Thus it has been broken in an old person while rising from a seat, while walking across the floor, or by the slight concussion caused by stepping from a higher to a lower plane, especially by slipping off from a curb-stone, by falls from a height upon the knees or upon the feet, by a sudden twisting of the limb, as when the toe trips upon the carpet.

Rodet concluded, from a series of experiments instituted upon the cadaver, that the direction of the force determined not only the point of fracture, in the case of the neck of the femur, but also its direction, and that a blow upon the outside of the trochanter major never caused an intra-capsular fracture. His observations possess great value, but as applied to the living subject his conclusions are somewhat too absolute. In old age a fall upon the trochanter is quite as likely to cause an intra-capsular fracture as an extra-capsular, yet it is more likely to be oblique, or impacted. In middle life a fall upon the trochanter seldom, if ever, causes an intra-capsular fracture. If, however, the neck is broken at all in these cases, it is most certainly without the capsule.

Signs of Intra-capsular Fracture.—When the neck of the femur is broken within the capsule by the application of a slight force, as often happens with old people, there may be little or no immediate displacement of the fragments. The same thing, as we have seen, occurs in other bones, where they are broken by muscular action alone. Displacement will, however, almost certainly ensue after the lapse of a few days or weeks, in consequence partly of the action of the muscles, but mostly in consequence of the inevitable absorption of a large portion of the neck. I speak of the disappearance of the neck as "inevitable," unless union by bone occurs; and the chances of this latter result remain to be considered.

When, also, the neck is broken within the capsule by a more considerable force, operating in the line of the axis of the neck or nearly so, causing impaction of the fragments, the displacement exists only in the direction of the axis of the neck; or, if there is actually some little displacement in the direction of the axis of the shaft, it may be too slight to be easily determined by measurement.

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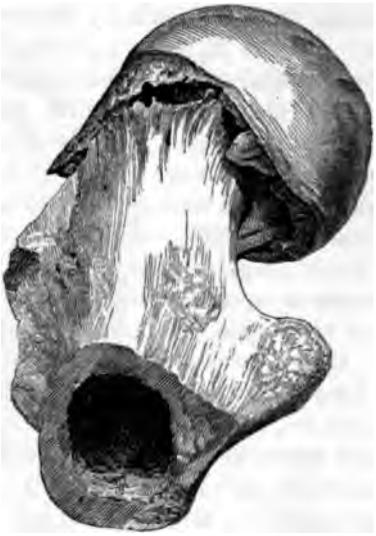
[1] *Canton's Observations*, London, 1855. *Robert Smith on Fractures*, Dublin, 1847.

In some few of these latter cases it is affirmed that bony union is possible either with or without absorption of the neck; so that, if this point may be considered established, there will be presented examples of intracapsular fracture without any very appreciable shortening of the limb either at the moment of the accident or at any subsequent period.

In other cases the periosteum and reflected capsule being more or less torn, a shortening occurs immediately, to the extent of from half an inch to an inch.

Crepitus is often absent, owing to impaction, or because the fragments having been completely displaced, their broken surfaces cannot again be brought into apposition; nor will a judicious surgeon manipulate violently in a suspected fracture, in order to detect crepitus, since he will thereby cause displacements and lesions, for which a more complete diagnosis is a feeble compensation.

Fig. 84.



Impaction within the Capsule. Bigelow.

Usually the broken limb lies parallel with the opposite one, the toes being everted; in a few cases, however, the broken limb is moderately abducted but still the eversion is present.

I have seen this fracture without eversion of the foot; but such examples are so exceedingly rare that one may pronounce very safely, when eversion is absent, and there is no shortening or crepitus, that it probably is not a fracture.

Pain in the neighborhood of the fracture, with swelling, tenderness, and occasionally discoloration, are also signs of some value. Inability to lift the foot from the bed is certainly present in most cases, but it is a symptom so often present in other accidents of the hip, that it cannot be regarded as very diagnostic.

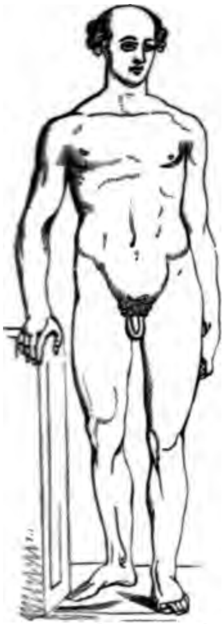
In most cases there is less prominence of the trochanter than on the opposite side; and, if the limb is shortened, the trochanter approaches more nearly to the ala of the pelvis. Whenever it is possible and proper to rotate the limb with some force, we shall occasionally notice that the trochanter moves upon a radius shorter than the entire length of the neck and head.

Signs of Extra-capsular Fracture.—The limb is shortened immediately more or less; the shortening, however, seldom exceeds one inch, and in general it is found to be about half or three-quarters of an inch. This is due to impaction.

The foot is almost always everted, while the whole limb lies parallel with the other. In very exceptional cases it is not everted, and still more rarely has it been found inverted. Crepitus is sometimes absent, but less frequently than in intra-capsular fracture. It is at least proper to say that in many cases it cannot be developed without the employment of improper force; and for the reason already given, namely, that impaction exists. There is pain, and almost certainly swelling, tenderness, and sometimes discoloration over the trochanter; it is generally impossible for the patient to lift the foot from the bed; the trochanter is less prominent, and approaches the ala of the pelvis; and if the surgeon thought it proper to employ sufficient force in rotation to disturb the impaction, he would find that the trochanter moved upon a shortened radius.

There is one other sign which is sometimes quite conclusive, namely, a manifest increase in breadth of the trochanter at its base, in consequence of its being split and spread open by the impaction. This is not, however, always apparent within the first few days; but subsequently, when bony callus is formed between and about the fragments, this greater breadth becomes very marked and quite diagnostic.

Fig. 86.



Fracture of Neck of the Femur.

I have not mentioned here the predisposing and exciting causes as differential signs of these fractures, although they possess great importance, because they have already been fully considered.

This enumeration of the signs of intra and extra-capsular fracture includes all that possess any real value; but, as will be seen, they are seldom absolutely conclusive. That is to say, they seldom determine positively whether the fracture is entirely within the capsule, or partly within and partly without; and, indeed, it may not always be clear that it is not wholly without. This difficulty in the diagnosis has always been admitted, and, as we shall soon see, constitutes the basis of important practical conclusions.

Fortunately the differential diagnosis between fractures of the neck of the femur, and dislocations at this point, is much more precise. The signs which distinguish these two accidents from each other will be considered in connection with hip-joint dislocations.

To appreciate the difficulties of the diagnosis between intra and extra-capsular fractures, it will be convenient to arrange the symptoms in parallel columns.

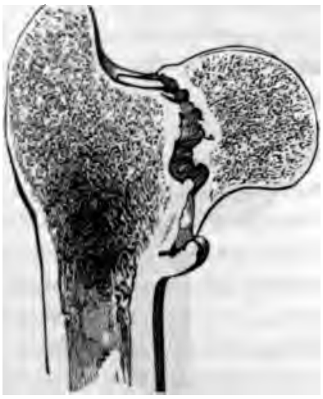
INTRA-CAPSULAR FRACTURES.	EXTRA-CAPSULAR FRACTURES.
1. Occurs usually after fiftieth year, sometimes much earlier.	1. Usually before fiftieth year, quite frequent much later.
2. Most frequent in women.	2. Equally common to both sexes.
3. Occasioned often in old age by slight accidents.	3. Never caused by slight accidents.
4. Occasioned most often by a force operating at or nearly at a right angle with the axis of the neck, as by a fall upon the foot; or by the weight of the body in rising, etc.; but in old persons it may be caused by a force operating in the line of the axis of the neck, or nearly in this line, as by a fall upon the trochanter.	4. Occasioned almost invariably by a fall upon the trochanter.
5. Often no immediate shortening. Sometimes shortened one inch or more.	5. Always immediate shortening, but seldom more than one inch; generally less.
6. Shortening almost or quite certain after the lapse of a few weeks; and finally may shorten two inches or more	6. Shortening does not increase by lapse of time.
7. In proportion to the shortening, the trochanter major approaches the ala of the pelvis.	7. In proportion to the shortening, the trochanter major approaches the ala of the pelvis.
8. Crepitus often absent, and usually less distinct.	8. Crepitus less often absent, and more distinct.
9. Cannot feel the fragments move under the finger.	9. Sometimes feel the fragments move under the finger.
10. Trochanter sometimes moves upon a shorter radius than is natural.	10. Trochanter sometimes moves upon a much shorter radius than natural; or, more properly speaking, the shaft of the femur rotates upon its own axis.
11. Foot almost always everted, and whole extremity lying parallel with the opposite one.	11. Foot almost always everted, and whole extremity lying parallel with the opposite one.
12. Cannot lift the foot from the bed.	12. Cannot lift the foot from the bed.
13. Pain, swelling, and tenderness, and sometimes ecchymosis, about the hip-joint.	13. Pain, swelling, tenderness and ecchymosis, especially over the trochanter major.
14. No expansion at the base of the trochanter major.	14. In general some immediate expansion at the base of the trochanter; and this expansion almost invariably manifest after some weeks or months.

Closely as the differential signs of these two accidents may approximate to each other in certain cases, the widest difference prevails in their results. In the one case bony union is, to say the least, almost invariably denied; while in the other it is quite as invariably permitted.

Let us consider the prognosis of intra and extra capsular fractures a little more in detail.

When the facture is wholly intracapsular a large portion of the neck is in general rapidly absorbed, and either no union of any kind takes place, the broken surfaces eventually becoming smoothed, hardened, and even polished where they are brought into contact; or, as is usually the case, union by ligament occurs: the ligament being longer or shorter according to the amount of displacement. The limb becomes, therefore, in general, much shortened, much everted, and the patient is unable to walk without a cane or a crutch.

Fig. 86.



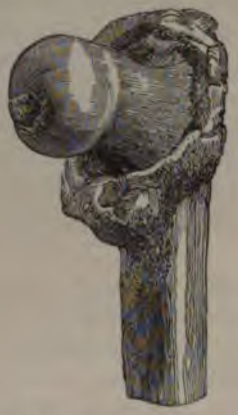
Intra-capsular Fracture united by Ligament.

Why it is that the neck disappears, and that bony union seldom or never ensues, will be easily understood. The fracture generally occurs in old people whose reparative powers are feeble: the neck of the femur is that portion of the skeleton in which the process of repair is the earliest to fail; when the fragments are separated or not impacted, we have the most powerful muscles in the body to antagonize, in order to secure and maintain apposition; when this action is not completely antagonized, the fragments do not overlap and lie in contact side by side, but they separate completely; there are no soft tissues adjacent which have suffered lesion, and which might aid in the process of bony repair; the synovial fluid is freely admitted between the broken surfaces; and, finally, the vascular supply to the upper fragment is almost completely cut off.

It is scarcely necessary, then, for any practical purposes, to again discuss the long-disputed question whether bony union has ever taken place in these cases. It may be admitted that it has taken place in a few exceptional examples of impacted fracture; yet it has never been my fortune to find a specimen in which this fact has been established. This much at least will not be denied by any one, namely, that such examples are exceedingly rare. In the earlier editions of my treatise on Fractures and Dislocations, I have given to this subject a full consideration; nor have any more recent observations furnished me additional light; and I content myself, therefore, with thus briefly reaffirming the conclusions there reached.

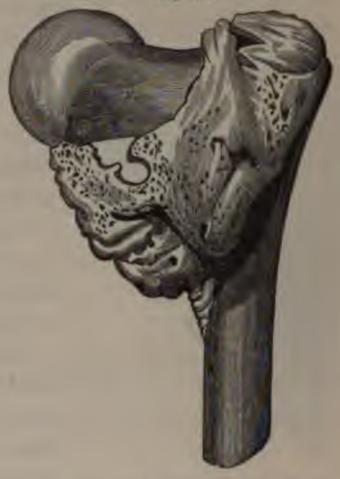
Prognosis in Extra-capsular Fractures.—These fractures are almost invariably impacted; the neck being driven into the shaft and base of the trochanter, splitting the trochanter and the upper end of the femur into several small fragments. The fragments are not, however, completely detached from each other, or even widely separated, owing to the strength of the aponeurotic expansion and tendinous attachments which surround them.

Fig. 87.



Impacted Extra-capsular Fracture. Repair Incomplete.

Fig. 88.



Impacted Extra-capsular Fracture, after consolidation.

The impaction continuing, bony union takes place with great certainty and rapidity, and without any disappearance of the neck by absorption. The trochanteric fragments generally remain perceptibly separated; but in addition to this there ensues, very often, an extraordinary deposit of bone, outside of the capsule, in the form of spindles, called osteophytes, which sometimes surround the neck like a coronet, and even project upward at points until they reach the pelvic bones.

Treatment of Intra and Extra capsular Fractures.—It was the opinion of Sir Astley Cooper that, considering the improbability of bony union in cases of intra-capsular fractures, under any plan of treatment, and the danger of the patient's becoming bedridden, or of sinking under protracted confinement, it would be better in all cases to disregard the fracture wholly, leaving the patient for a time in whatever position was found to be most comfortable, and then to get him upon crutches as speedily as possible.

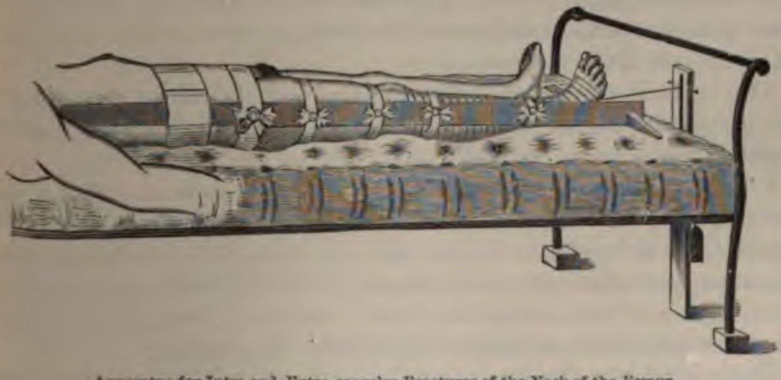
I cannot entirely agree with this distinguished surgeon in this matter. Sir Astley did not deny the possibility of bony union. He admitted, moreover, the impossibility sometimes of establishing a complete diagnosis, since it could not always be affirmed that the fracture was not partly within and partly without the capsule. Occupying myself the same position in reference to these two points, I do not see how we can properly disregard treatment. On the contrary, we ought, I think, to treat all cases of intra-capsular fracture, including even cases of suspected fracture, as if we knew them to be in a condition favorable for bony union: provided only that from day to day we attentively observe the condition of the patient, and that whenever a failure of strength, which can be fairly traced to the confinement, is noticed, we shall lose no time in accepting Sir Astley's advice.

It is believed, moreover, that by the plan of treatment which will hereafter be described and recommended, we shall insure a longer limb and less eversion, in case no union by bone takes place; and that, by the moderate extension employed, we shall save the patient from much of that pain and suffering which is often due to the irregular contractions of the muscles, and to the pressure of the broken fragments against inflamed tissues. Indeed, a large experience leaves me no room for doubt upon these points.

One other and very marked advantage of this method, which I have now for some time practised, is, that it is equally suited to all the forms of fracture of the cervix femoris, and, in case the precise point of fracture may not be determined, the treatment will nevertheless be appropriate.

It may be as well to say that I have long since arrived at the conclusion that all fractures of the thigh-bone can be treated more successfully in the straight position than in the flexed; and that in nearly all cases extension is more effectually made by the weight and pulley than by any other method. My plan of treatment in fractures of the neck is therefore only a modification of the plan to be recommended in fractures of the shaft of the femur. For the details of this plan the reader is referred to fractures of the shaft. The peculiar modifications required for fractures of the neck will be briefly explained here.

Fig. 89.



Apparatus for Intra and Extra capsular Fractures of the Neck of the Femur.

Having placed the patient upon a suitable bed, the extending bands of adhesive plaster are to be secured to the leg of the broken limb, and attached to a rope passed over a pulley at the foot of the bed, which is now elevated four inches, and a weight equal to about ten pounds is suspended from the cord. In this manner the requisite extension and counter-extension is effected. It will hereafter be seen that in fractures of the shaft of the femur we generally employ about twenty pounds; but in the case of intra-capsular fracture, very little advantage would be derived from so severe extension, and very few of the old people, in whom these accidents so generally occur, could endure it; while in the case of extra-capsular fracture, inasmuch as it is never the intention of the surgeon to overcome the impaction, but only to steady the limb, and perhaps to prevent any further shortening, ten pounds is sufficient, and more than this would prove mischievous.

Side or coaptation splints are, of course, unnecessary; but there remains one more indication to be accomplished, namely, to prevent as much as possible the tendency in the limb to become everted. In most cases this result cannot be altogether prevented by any means which may be adopted, but by a well-supported long side splint the eversion may be restrained. This splint should be long enough to extend from a little below the axilla to two inches beyond the foot, and its width should be about four inches. From the outer side of its lower extremity should project to the distance of six inches a piece of board, of the same width and thickness as the side splint, supported against the side splint by a knee, to give it firmness. Thus constructed, the splint is laid beside the body, with soft pads interposed, and is made fast to the pelvis, thigh, and leg, by a few turns of a roller.

Fractures of the Shaft of the Femur.—To avoid repetition in the discussion of fractures of the shaft of the femur, I shall arrange them all in a single group, considering, under the same general division, fractures just below the trochanters, fractures in the middle portions, and fractures just above the condyles.

This is rendered convenient by the fact that the causes, the signs and the prognoses are so nearly identical; and, moreover, the treatment ought, in my opinion, to be the same.

Fractures of the shaft are, with very rare exceptions, oblique; and the fragments are usually made to override, by the contraction of the muscles, to the extent of from half an inch to two inches or more. Fractures just above the condyles are in most cases oblique from above downwards and from behind forwards; and the lower end of the upper fragment is sometimes almost buried under the patella.

There is seldom, if ever, any difficulty in determining upon the existence of a fracture of the shaft, the mobility being alone in most cases a sufficient means of diagnosis.

In reference to the prognosis surgeons have not been always agreed; for while a large majority of the most experienced surgeons in all countries, and in all periods of the history of surgery, have acknowledged their inability to restore most broken femurs to their original length, a few less distinguished, less observing, or less honest surgeons have from time to time claimed that they seldom or never fail to make these bones unite of the same length as before, if indeed they do not sometimes happen to make them a little longer.

Among those who have not been able to overcome the shortening, except in a few rare cases, are to be mentioned, Hippocrates, Avicenna, Celsus, Scultetus, Chelius, John Bell, Benjamin Bell, Velpeau, Nélaton, Erichsen, Valentine Mott, Knight, Buck, Detmold, J. Mason Warren, and Gross. With precisely the same appliances, or with only such trivial and unessential modifications as could in no ways affect the results, a few surgeons, such as South, Hunt, Gamgee, Dorsey, Scott of Montreal, Armstrong, and perhaps some others of no greater claim to recognition as authority, have succeeded always in making perfect limbs.

I have myself often met with this latter class of men; and I have also seen the results of their practice, both in this city and elsewhere; and it has never surprised me to find that, so far from always making thighs of the same length as before, they almost constantly fall considerably short of my own standard of average results. In other words—to state a matter of fact very plainly—through ignorance, inadvertence, or intentionally, these men do not tell the truth.

The following is a summary of my own conclusions, and of the conclusions of the most experienced surgeons everywhere, as to the results of a skilful treatment of these fractures.

First. In a larger proportion of cases than in any other fractures, excepting only the fractures of the humerus, bony union will not take place.

Second. When the fracture is oblique, and the patient is an adult whose muscles are not paralyzed, and therefore offer the ordinary resistance to extension, more or less shortening will almost always result.

Third. In the case of children or of persons under fifteen or even twenty years of age, oblique fractures quite often unite with little or no shortening.

Fourth. The same results will occur in cases of transverse fractures as usually occur in oblique, if the broken ends are completely displaced; unless the apposition can be restored, so that the ends rest upon and support each other.

Fifth. In all fractures, whether of adults or children, where the fragments have never become completely displaced, union without shortening may be expected.

Sixth. When, in consequence of displacement, an overlapping continues, the average amount of shortening in adults, in simple fractures, will be about three-quarters of an inch, and ranging from one-quarter of an inch to one inch and a half: nor will a greater amount of shortening necessarily imply unskilful management.

Seventh. With children the average amount of shortening is probably from one quarter to half an inch.

Eighth. Compound fractures, including nearly all gunshot fractures, unite generally with a shortening of from one and a half to three inches or more.

Treatment of Fractures of the Shaft.—The question in relation to the treatment of fractures of the femur, which has given rise to the greatest diversity of opinion among surgeons of the present day, is that of position; and upon this point the testimony of authority may be briefly stated as follows:

Until Percival Pott wrote his treatise on fractures, about the middle of the last century, nearly all surgeons had treated fractures of the thigh in the straight position. From that period up to about the close of the first quarter of the present century, probably a majority of surgeons adopted the flexed position recommended by Pott. To-day the vast majority of the leading hospital surgeons in Europe and in America have returned to the straight position; and so nearly universal is the testimony in its favor that I shall feel excused in this general treatise from repeating the arguments upon which this preference is based.

For myself, I make no exceptions, since I find that the straight position gives to the patient less inconvenience, and secures the best results, whether the fracture is in the neck, in the shaft below the trochanters, in the middle portions of the shaft, above or through the condyles; whether the patient is a child or an adult; whether it is a simple, compound, or comminuted fracture, including, of course, all gunshot fractures.

I do not find, however, that precisely the same form of apparatus is suited to all fractures of the shaft of the femur, but that certain modifications are required: first, for simple fractures occurring in adults; second, for simple fractures occurring in children; and third, for all compound fractures, including gunshot.

Treatment of Simple Fractures occurring in Adults.—The arrangement or construction of the bed ought to engage our first attention. A variety of "fracture," or "invalid" beds have, from time to time, been constructed; such as Jenks's,[1] Daniels's,[2] Burges',[3] Hewson's,[4] Crosby's,[5] Barton's, Coates's,[6] and Russell's, all of which possess many points of excellence, and such as render them useful in many cases; but they are more or less complicated, and therefore very liable to get out of repair; they can seldom be obtained at the moment they are needed; and, fortunately, experience has proven that, while they may be useful and convenient in certain cases, they are seldom if ever absolutely necessary. At Bellevue we never use them, nor are they often used in any hospital with which I am acquainted. It must be understood, however, if these complicated fracture beds are not required, it is only because an ingenious surgeon can always convert an ordinary bed into a complete fracture bed, and no ordinary bed is ever fit for this purpose until it has been thus reconstructed.

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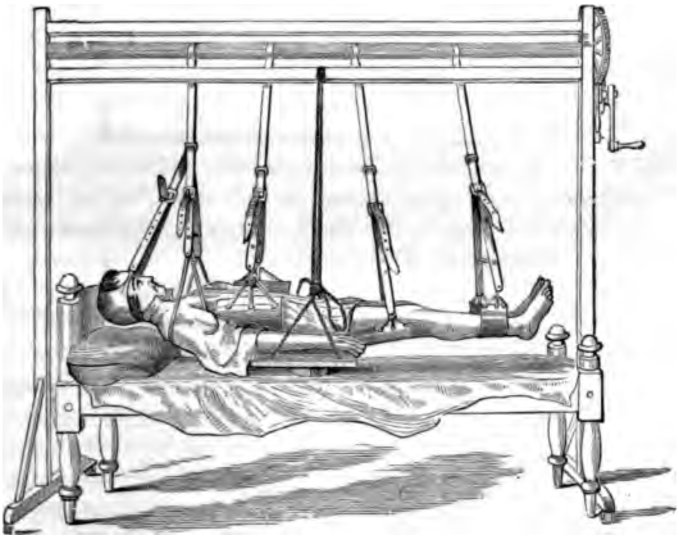
[1], [2], [3] The author's *Treatise on Fractures and Dislocations*, 4th ed.

[4] *American Journal of Medical Science*, July, 1858.

[5] The author's *Treatise on Military Surgery*, pp. 413, 414.

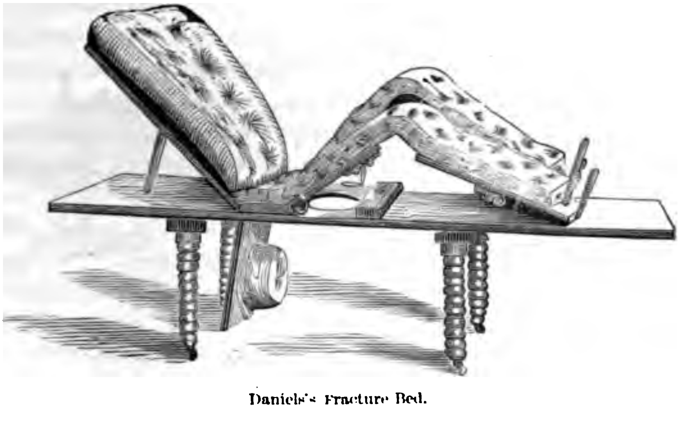
[6] *Eclectic Repository*, 5th and 9th vols.

Fig. 90.



Jenks's Fracture Bed.

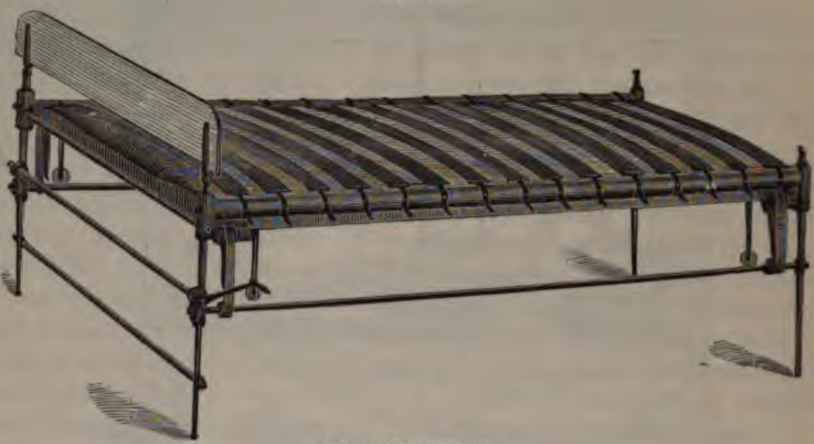
Fig. 91.



Daniels's Fracture Bed.

The bed should have a firm floor made of boards, upon which the mattress should rest, and care must be taken that the bed has sufficient length. If necessary it can be lengthened by removing the foot-piece and allowing the boards which constitute the floor to project one or two feet beyond the foot of the bedstead.

Fig. 92

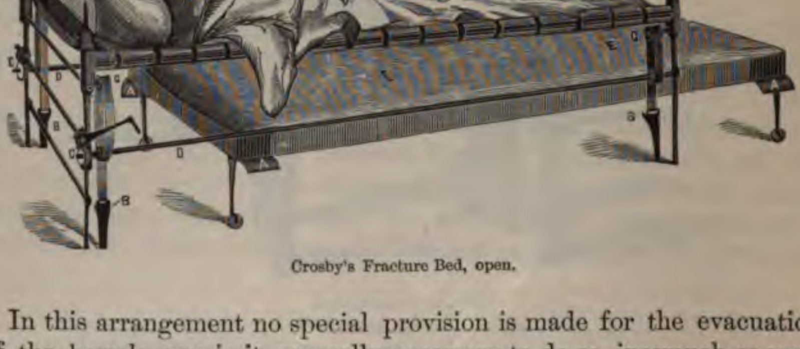


Crosby's Fracture Bed.

In case a four-posted bedstead cannot be obtained, a cot-bedstead may be made to serve the purpose very well, by constructing a floor of the proper length and breadth to support the mattress.

Upon the mattress are to be placed a sufficient number of quilts to render the bed comfortable, and a cotton or linen sheet.

Fig. 93.



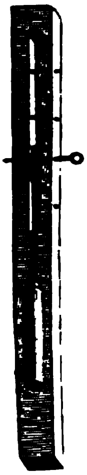
Crosby's Fracture Bed, open.

In this arrangement no special provision is made for the evacuation of the bowels, nor is it generally necessary to do so, inasmuch as most patients are able to use a properly constructed bed-pan, by sliding it partially under the nates, without disturbing the broken limb. If, however, the surgeon chooses to make such provision it can be done by making a circular hole in the mattress and a corresponding hole in the floor of the bedstead, which, when not in use, will be kept closed by a folded blanket resting upon a stool underneath the bed.

Extension and counter-extension will be most conveniently and efficiently made in the following manner:

Saw from a half-inch board a strip four inches in breadth, and of such length that, when made fast to the foot of the bedstead, it shall rise four inches above the toes of the patient as he lies supine upon the bed. Construct a long slot in the upper portion of this strip, intended to receive a pulley. Make holes with a gimlet from side to side through the strip, traversing the slot: the holes being about three-quarters of an inch apart. These holes are intended to receive a large wire, which will serve as the axis upon which the pulley will turn. In case a metallic pulley cannot be obtained, a spool will serve the purpose. This piece of board, thus constructed, is to be fastened upright to the foot of the bed.

Fig. 94.

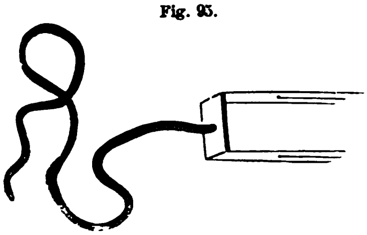


Upright Board and Pulley.

In order to complete the apparatus for extension there will be required a small rope four feet long, a bag of sufficient size to hold twenty-two pounds of sand or of small shot, and a piece of thin board four inches long and three and a half inches wide, to traverse the sole of the foot, and prevent the adhesive plaster bands from pressing upon the malleoli. This traverse must be perforated in the centre to receive the cord, in the end of which a knot is to be made which will prevent its being drawn through. Half a pound of cotton batting, cotton or woollen rollers, four feet of strong adhesive plaster, and two small blocks, or bricks, to place under the foot-posts of the bedstead will also be required.

The adhesive plaster extending band will be composed of one single piece, which, for adults, must generally be about four feet in length, and three and a half inches in breadth; but as it approaches the middle it should widen to about six inches, so that when the traverse is laid upon the middle of the band, the margins of the band may be folded over the sides of the traverse.

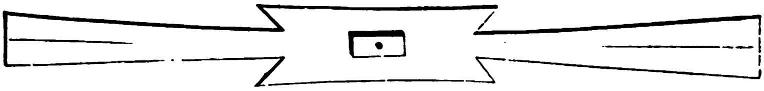
Fig. 95.



Traverse.

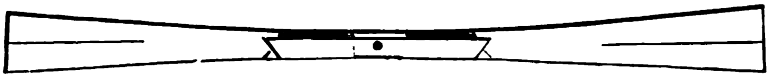
The rope having been knotted at one end, is now passed through the hole in the traverse, and while an assistant steadies the foot, the extending band is applied to each side of the leg as high as the knee, the traverse touching the sole of the foot. If the straps are found to be longer than the leg the ends may be left, and folded down upon the roller after the first turns are applied. The application of the roller, intended to hold the bands in place, will be commenced at the ankle, but first the instep and the back of the leg above the heel must be well covered with cotton batting, and if the patient is very thin it is well to cover the whole length of the spine of the tibia in the same manner. The roller may now be applied over the bands as high as the knee, and the superfluous ends of the bands being doubled down, it may be made to return a short distance towards the foot.

Fig. 96.



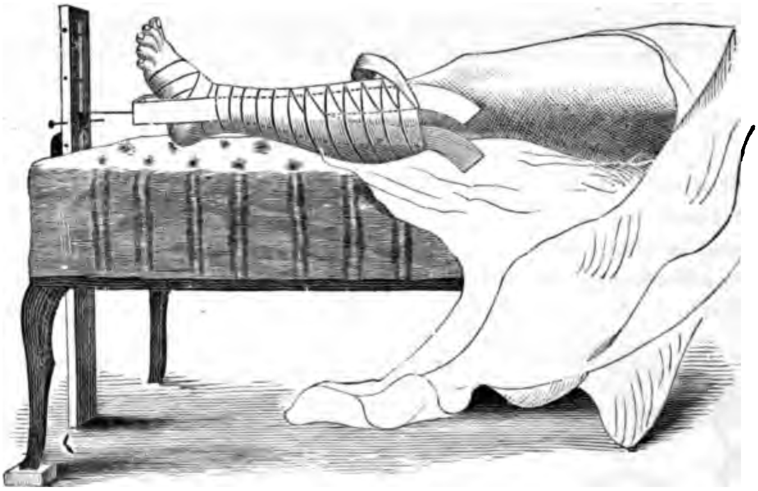
Adhesive Strip Extending Band, with the Traverse in position, but not enclosed in the margins of the band.

Fig. 97.



Same as above, with Traverse enclosed.

Fig. 98.



Mode of applying Adhesive Strips.

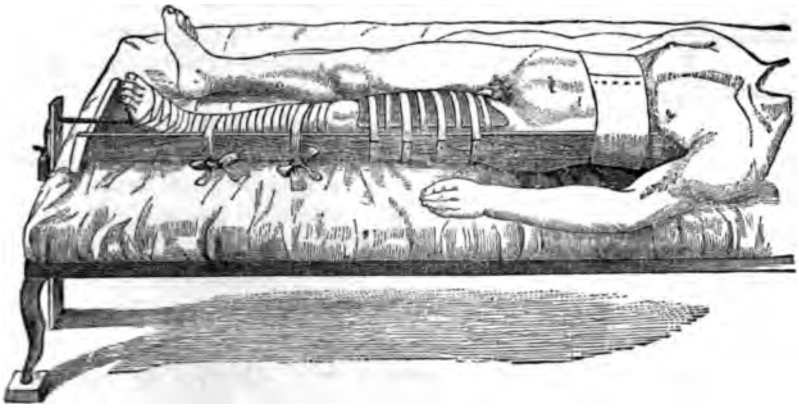
Passing the rope over the pulley and attaching the weight, extension will be made. The pulley ought to be about one inch higher than the middle of the sole of the foot, so as to lift the heel gently from the bed. The amount of weight to be employed, or which the patient can endure, will vary somewhat. I have found the maximum to be about twenty-two pounds, and generally patients will not endure for any length of time over twenty pounds.

To render it more certain that the patient will not be drawn toward the foot of the bed by the continuous extension, the foot-posts must be lifted about three or four inches by blocks or a couple of bricks.

To secure coaptation and support to the fragments, four splints, made of sole leather, and covered with cotton cloth, must be applied to the circumference of the limb. These splints should not quite touch at their margins. The inside and outside splints ought to be long enough to embrace the condyles; and the posterior splint should be wider than either of the others, and extend from the tuber ischii to a point below the knee. The whole is to be secured in place by four or six strips of bandage knotted over the front splint, and stitched fast to the covers of the side splints to prevent displacement.

To obviate the tendency to eversion which exists in nearly all fractures of the femur, a long side splint, four inches wide, and extending from near the axilla to beyond the foot, well padded with cotton batting enclosed in the cover of the splint, must be laid outside of the limb and body. From the lower end of this splint, a foot-piece should project six or eight inches outward, the more effectually to prevent eversion. The whole is to be secured to the leg, thigh, and body by separate bands of cotton cloth.

Fig. 99.



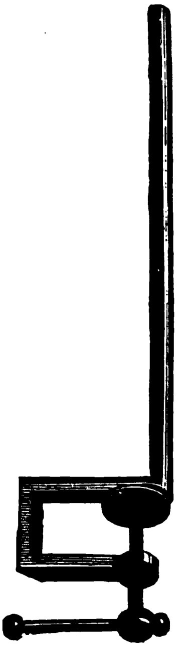
The author's dressing for fracture of the shaft of the femur.

Eight weeks is the usual time which a fracture of the thigh in an adult ought to remain in apparatus. The extension may, however, be lessened as soon as the bone seems firm; and as early as the fifth or sixth week passive motion should be given to the knee-joint.

Treatment of Fractures of the Thigh by Plaster-of-Paris.—In the earlier editions of this book I have said that the value of this mode of treatment does not appear to be fully decided. A further personal experience, together with the personal experience of others as it has come to my knowledge, enable me now to say that the plaster-of-

Paris is not a safe or judicious dressing for fractures of the thigh, either for fractures through the shaft, or for fractures near the upper or lower extremities of the bone, for fractures in children or in adults, for compound or simple fractures. Its use under all the circumstances named has been followed by a larger proportion of failures and disasters than any other plan of treatment known to me, such as great shortening of the limb, deformity, non-union, delayed union, gangrene and death. In corroboration of these statements, and for a more full explanation of the causes of these disasters, I must refer the reader to the 7th edition of my work on Fractures and Dislocations.

Fig. 100.



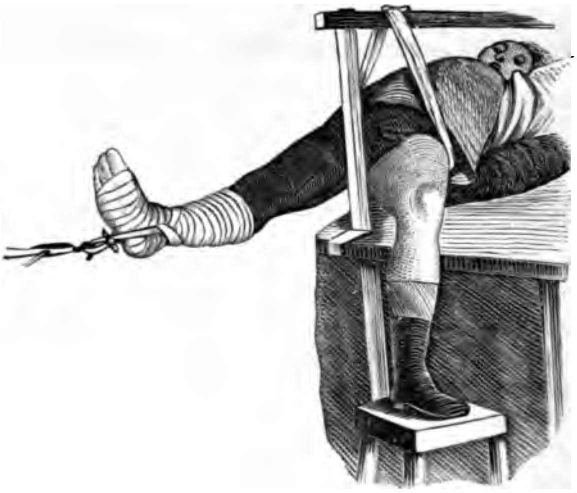
Stanchion.

The plaster, when employed, is to be applied in the following manner:—

First, a plaster-of-Paris bandage is applied to the foot and leg two or three hours before the reduction of the fracture is attempted, or sufficiently long before for it to become hard. The patient is then placed upon a table with his nates overhanging one corner. The perinæum is pressed against an iron stanchion, which is firmly screwed upon the lower end of the table, and wound with heavy flannel cloth. The nates are then suspended by a sling which passes under the small of the back, and which is supported by a wooden bar projected horizontally from the top of the stanchion to some point of support of equal elevation beyond the head.

The pulleys then being attached, traction is made to the extent which the patient can bear, or which may be necessary

Fig. 101.



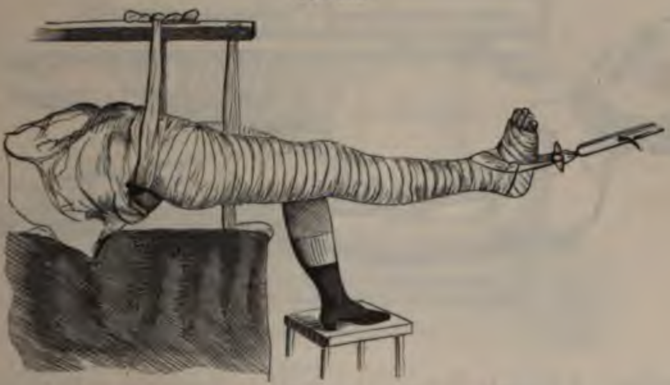
Thigh wrapped with flannel, and extension applied.

and safe. The direction of the extension must be in the line of the axis of the body, it having been observed that when the plaster is applied with the limb abducted, too much pressure is brought upon the perinæum when the limb is again dropped into line; and if the limb is adducted when the plaster is applied, the dressing will be too loose about the groin in the straight position. The bandages, saturated with plaster in the manner already directed in the section on the general treatment of fractures, are applied over the whole limb, from below upwards, including the pelvis. Occasionally the successive turns of the roller are re-enforced by broad pieces of flannel or of patent lint, dipped in the fluid plaster. The number and thickness of the successive layers must be determined by the apparent necessities of the case, generally four or five layers of roller being required; at least upon the thigh.

I have omitted to state that excoriations caused by the dressing have been noticed most frequently in the groin and gluteal fold; this may, however, be avoided by placing a heavy piece of dry flannel over these parts previous to the application of the plaster.

The dressing being completed, the extension is continued fifteen or twenty minutes until the plaster has become hard.

Fig. 102.

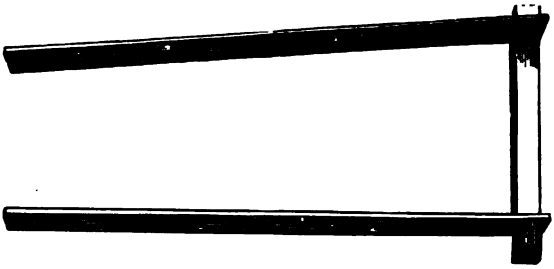


Extension continued after the dressing is complete.

Treatment of Fractures of the Thigh in Children.—With children I employ the same mode of dressing as in adults, so far as the means of extension are concerned, excepting that the extending weight is lessened, and sometimes omitted altogether; and occasionally it is found advantageous to employ a perineal band, made fast above to the head of the bed, and which, being drawn only moderately tight, serves as a restraint against the child's disposition to slide down.

With children the greatest difficulty is in preventing them from rolling over and twisting about in every direction. This is completely obviated by placing a long splint, such as I have described for fractures of the thigh in adults, on each side of the body, and uniting them below the feet by a transverse piece of board; and, while extension is made only from the broken limb, securing each leg and thigh to its respective long splint, and to the body also.

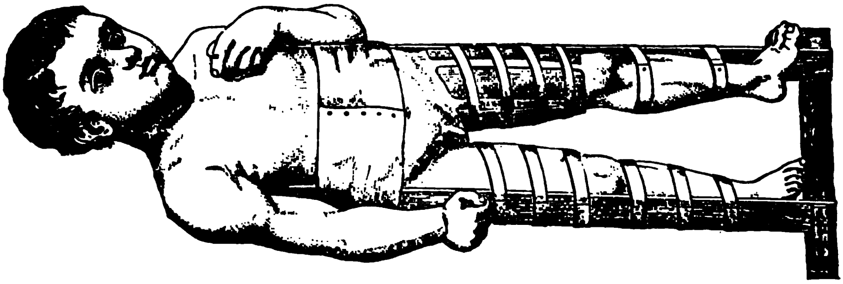
Fig. 103.



Thigh Splint for Children.

In addition to the quietude which this plan insures, it will be found that it furnishes a kind of movable fracture bed in which the little patient can be carried securely from one place to another.

Fig. 104.



The same applied.

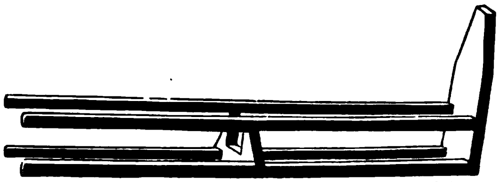
In the case of female infants it is well to have the splints spread a little at the bottom, so as to separate the thighs slightly.

Treatment of Compound Fractures of the Thigh, including Gunshot Fractures.—While many excellent surgeons, who employ the straight position in other fractures of the femur, prefer to adopt the flexed position in gunshot and in all compound fractures of this bone, my experience leads me to give the preference here also to the straight position; and, moreover, while most surgeons have thought proper to reject extension altogether in this class of fractures, it has proved in my hands one of the most reliable means of securing rest and comfort to the patient, by preventing the contraction of the muscles and consequent goading of the inflamed tissues by the fragments of bone: it has secured to the patients longer limbs, and union with less lateral deformity.

Indeed, inasmuch as we cannot usually employ lateral support in these cases, extension is almost our only reliable expedient to prevent lateral displacement. It is nevertheless true that violent extension, or such as may be properly used in simple fractures, is painful and mischievous; even with adults, the amount which can be tolerated will seldom exceed fifteen pounds, and sometimes five pounds will be the limit.

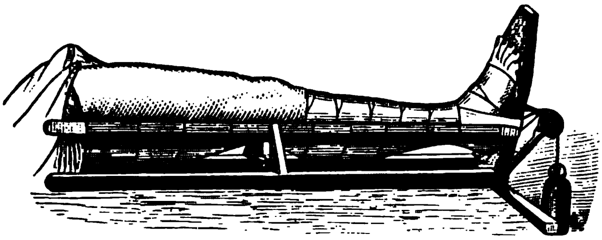
I employ for these fractures a modification of the excellent apparatus invented by Dr. Hodgen of St. Louis, late surgeon U. S. Vols., composed of four parallel bars, constituting a skeleton box, in which the limb is suspended upon strips of bandage made fast on either side by pins projecting downwards beneath the two upper bars. By doubling each strip of bandage and stitching them on one side, the pins may be dispensed with.

Fig. 105.



Hodgen's apparatus for Gunshot Fractures of the Thigh.

Fig. 106.



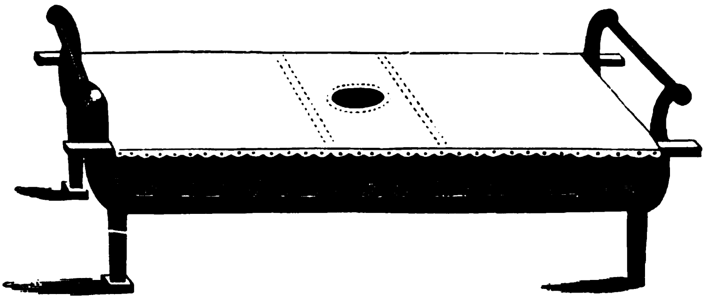
Same with limb in position.

A long outside splint, constructed as I have described for the prevention of eversion, the continuity of which is interrupted for a space of four or six inches opposite the fracture, and reunited by projecting iron brackets, will answer very well in ordinary compound fractures which are not the result of gunshots.

The following wood-cuts will explain a movable bed or stretcher which I have used to advantage in army practice, and which admits also of the employment of moderate extension. A long side splint may be added sometimes.

Of the various double-inclined planes none are better than Hodgen's wire suspension apparatus, N. R. Smith's anterior splint, or a double inclined plane made of boards, with a joint corresponding to the knee, and a foot-board. Nearly all of the complicated, flimsy, patented double-inclined planes invented by mechanics, and hawked about the country by agents, are simply worthless.

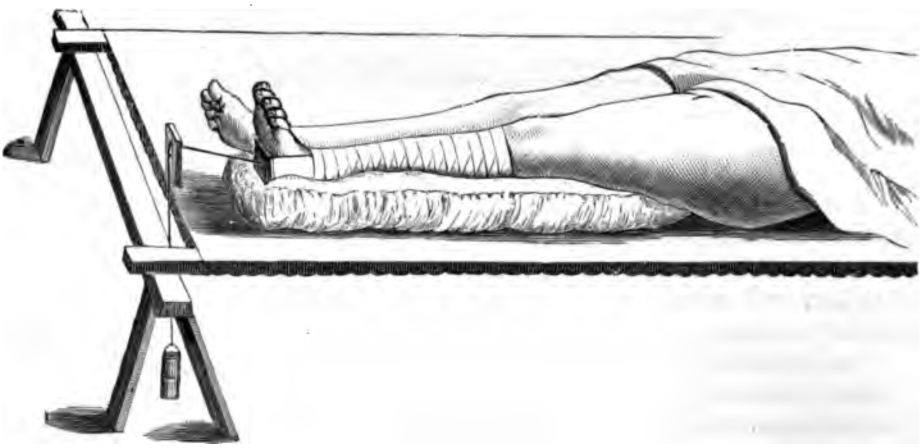
Fig. 107.



Canvas Frame on a Bed.

Fractures of **One or Both of the Condyles** are not very frequent, and in most of the cases which do occur, the injury is so serious as to demand amputation. In case it is determined that amputation is not necessary the nearly straight position—the leg and thigh being made to repose in a long, well-cushioned fracture-box—will generally be found to answer the indications most completely. When the fracture implicates both condyles, extension will be required. Splints and bandages are in general not indicated, but I have lately seen one of these fractures do exceedingly well in the plaster-of-Paris dressing.

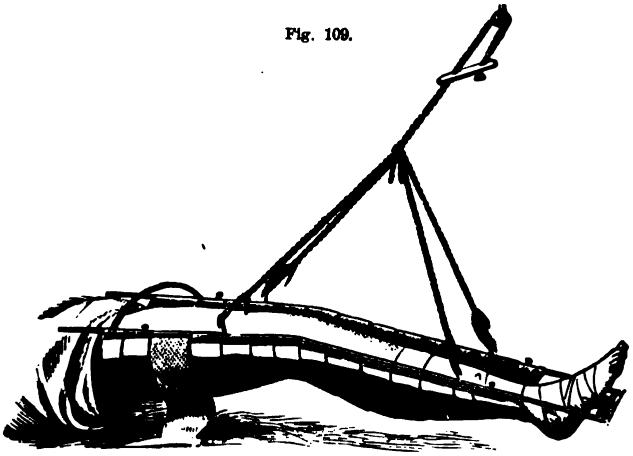
Fig. 108.



Canvas Frame removed from the Bed and laid upon "Horses."

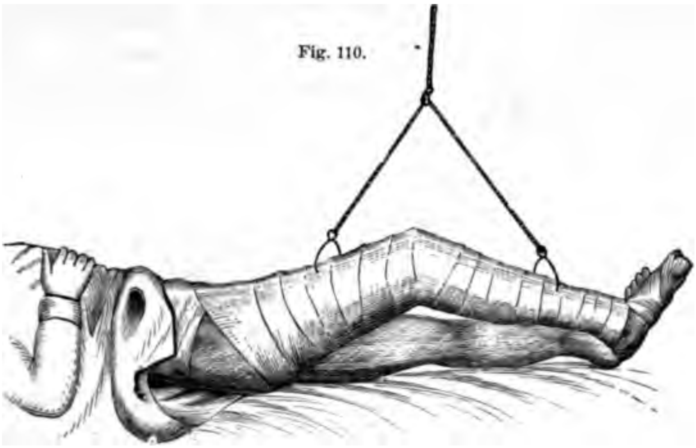
A few examples of **Separations of the Upper and Lower Epiphyses** of the femur have been reported. Separation of the lower epiphysis is the most frequent, having been occasioned in some instances by attempts to overcome anchylosis at the knee-joint. The diagnosis and treatment of these injuries demand no special consideration.

Fig. 109.



John T. Hodgen's Wire Suspension Splint.

Fig. 110.



N. R. Smith's Anterior Splint applied.

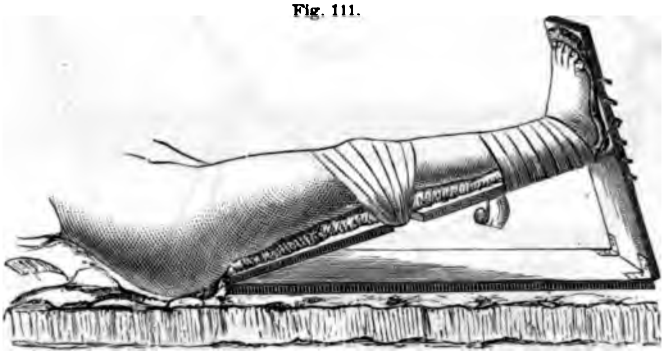
Fractures of the Patella.

The patella is occasionally broken by a direct blow; but most often it is caused by the action of the muscles alone, as when one attempts to save himself from falling.

The fracture is, usually, transverse, but in rare cases the line of fracture is oblique or longitudinal; sometimes it is comminuted. The diagnosis is, in general, easily made, although in many cases of transverse fracture it may be difficult or impossible to discover crepitus. Ordinarily the original displacement of the upper fragment is ab three-quarters of an inch, but in some cases it is much

The treatment consists in elevating the limb upo inclined plane, so as to relax the quadriceps femoris, and then securing the upper fragment in place by a roller; after which the whole must be supported upon the splint by a roller extending from the foot to the groin. In the accompanying drawing this last-named roller is only applied to the lower portion of the leg, the dressing being incomplete.

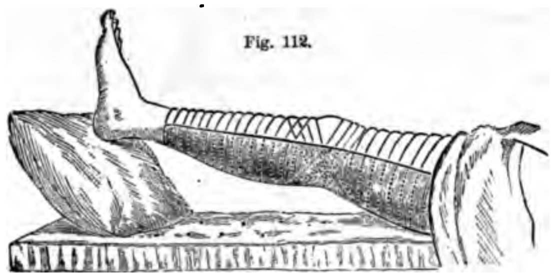
Fig. 111.



The author's apparatus for fractured patella when the separation is considerable.

When the separation of the fragments is not considerable, the dressing with a gum-shellac cloth splint, as shown in Fig. 112, will suffice.

Fig. 112.



The author's dressing when the separation is moderate. The final turns of the roller in front of the patella are not shown in the woodcut.

The patella, having been broken transversely, usually unites by a short ligament. If, however, the ligament is not more than half or three-quarters of an inch in length, the limb will be as strong as if the fragments had united by bone. The cure cannot generally be considered completed under six or eight weeks; but, to prevent anchylosis, passive motion should be given to the joint as early as the fourth or fifth week. Great care must be taken, while employing passive motion, not to rupture the ligament; and when the patient is permitted to leave the bed, he must be cautioned against bending the knee forcibly or bearing great weight upon it. I have known the new ligament to be ruptured in several cases by attempts to rise from the sitting posture, and in others by bending the knee over the side of the bed. It has been observed also that the refracture, or, to speak more correctly, that the rupture of the newly formed ligament, is usually followed by greater retraction of the upper fragment, and that a reunion has seldom *thereafter* been effected.

Recently surgeons have occasionally practised wiring the fragments, "with antiseptic precautions." In the last American edition—the seventh—of my "Treatise on Fractures and Dislocations," I have discussed this subject quite fully, and have called attention to several examples of death caused by this practice. In this city one patient has lost the leg, and two have died in consequence of this operation, made in each case with strict "antiseptic precautions." Such experience renders argument unnecessary.

Fractures of the Tibia.

When the shaft of the tibia alone is broken there is usually very little displacement; and a single leather splint is sufficient to secure a good result. The malleolus internus is sometimes broken in connection with dislocations of the ankle; but the fragment is not generally much, if at all, displaced. A few examples of separations of both the upper and lower epiphyses have also been reported, but they do not usually become greatly displaced, and, having been adjusted, union has occurred promptly.

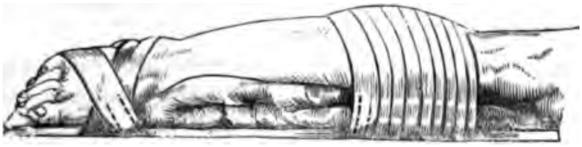
Fractures of the Fibula.

There is but one fracture of the fibula which deserves special mention, namely, a fracture about two or three inches above the lower end; and which is usually the result of a fall upon the foot, in consequence of which the foot is violently twisted outwards, and sometimes the ankle is itself dislocated, or rather the astragalus is rotated upon the tibia. This has been known generally among surgeons as a "Pott's fracture."

In case the foot has been thrown outwards with sufficient force to dislocate the ankle, or rotate the astragalus in its socket, there is sometimes, accompanying the fracture of the fibula, a fracture of the malleolus internus; or, as more frequently happens, a detachment of some portion of the internal lateral ligament from the malleolus internus. When either of these accidents has complicated the fracture of the fibula, the foot will be strongly inclined to fall outwards, and it is not certain that this inclination will ever be entirely overcome.

In a few instances, also, the astragalus will be inclined to a subluxation backwards upon the lower end of the tibia. I have reported several of these examples, including one case in which an autopsy was made at Bellevue Hospital.

Fig. 118.

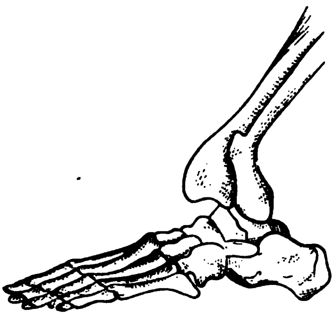


Dupuytren's Splint for Fracture of the Lower End of the Fibula.

When the foot is only inclined to turn outwards, the splint recommended by Dupuytren will most completely answer the indications.

This splint is constructed of a single board, about four inches wide, long enough to extend from the knee to a point two or three inches below the foot. A pad of the width of the splint, and of such length as to reach from the knee to the malleolus internus, three inches thick at its lower end and tapering to one inch at its upper, is laid upon the inside of the leg, and over this is placed the splint. A few turns of the roller will secure the upper ends of the splint and pad to the leg; while similar turns of the roller, at and below the malleolus, will secure the lower ends, and at the same time adduct the foot strongly towards the splint. The limb may now rest upon the heel, or, by flexing the leg upon the thigh, it may be made to rest very comfortably upon the side.

Fig. 114.



Dislocation of the Foot backwards after a Pott's Fracture.

If, however, the heel inclines to fall backwards, the limb must constantly rest upon the heel; or a posterior leather splint, fitted to the back of the limb and enclosing the hee., must be substituted for Dupuytren's splint.

The plaster-of-Paris dressing, if applied with great care, may also be employed in this fracture with a tolerable certainty of a good result.

Fractures of the Tibia and Fibula.

These fractures are mostly oblique, and generally unite with a shortening of half an inch. In exceptional cases there may be no shortening at all.

Simple fractures of both bones of the leg are in general best treated by two leather splints, one on either side, which are made to extend from above the knee to near the metatarso-phalangeal articulations; the limb, as soon as the second or third day, when the splints have become dry and hard, being suspended from a wire or wooden frame. In suspending the limb, the knee should be about one inch higher than the foot, and the heel should be elevated only so far as to clear the bed. By suspending the limb in this manner the patient is rendered more comfortable, and motion at the point of fracture is in a great measure obviated.

Extension and counter-extension can seldom be employed to advantage in these fractures; but in case it is attempted, adhesive plaster bands may be used for extension, the whole limb being placed in a straight position, as for fractures of the femur; the foot of the bed must also be slightly elevated, and the extension be made with a weight and pulley. From five to ten pounds is as much as can generally be borne.

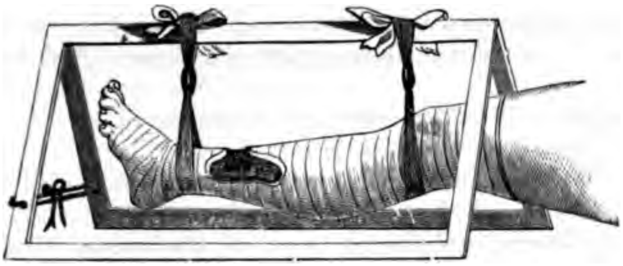
A compound fracture of the leg may be supported temporarily on a pillow covered with oil-cloth, between two well-cushioned side splints, or upon double inclined planes, such as Hodgen's suspending apparatus, but in many cases no mode of dressing these fractures during the first few weeks will be found so convenient as "Barton's bran-box." For this purpose a fracture-box is constructed with movable sides, which are to be secured in position with hooks made fast to the foot-piece. Over the box is laid a piece of cotton cloth wider and longer than the box, and upon this is poured sufficient bran to form a floor upon which the limb may rest easily; the leg is then laid in the box, and the upper end of the cloth is pinned around the limb above the knee; additional bran is packed between the sides of the box and the leg; and finally the box is suspended in the same manner that it has been advised to suspend the leg when lateral splints are employed.

The object in placing the bran inside of cloth, and not directly in the box, is to prevent its escape through the joints, and at the upper end of the box.

If the bran becomes soiled by blood or pus, that which is soiled may be at any time removed, and replaced by fresh bran, without disturbing the limb.

In the preceding pages I have already expressed my conviction, after a large experience in my own surgical wards, that the plaster-of-Paris dressing was eminently serviceable in compound fractures of the tibia and fibula. In order to insure its best results the dressing must be applied before swelling has taken place, or, if this is already present in any considerable degree, not until after the swelling has subsided. No special instructions are needed as to the mode of applying the plaster dressings, after what has been said upon this subject in the preceding pages, further than to say that a window must be made for the escape of pus, and that I generally find it comforting to the patient to swing the limb after the plaster has hardened.

Fig. 115.



Plaster-of-Paris dressing applied to a Compound Fracture of the Leg.

Fracture of the Bones of the Foot.

Fractures of the **Tarsal Bones** seldom require mechanical appliances for their support. They are, however, serious accidents, and occasionally result in the formation of abscesses, or in caries or necrosis of the bones. Absolute rest is the most important condition for their successful management.

Fractures of the **Metatarsal Bones,** and of the **Phalanges of the Feet** are to be treated upon the same principles as fractures of the corresponding bones in the hands.

CHAPTER XVII.

DISLOCATIONS.

SECTION 1.—GENERAL CONSIDERATIONS.

Division and Nomenclature.

DISLOCATIONS are divided into simple, compound, and complicated, partial and complete, recent and ancient, primitive and consecutive, unilateral and bilateral, single and double. We speak, also, of dislocations as traumatic, pathological, and congenital.

A **Simple** dislocation is a displacement of one bone from another at its place of natural articulation, with no lesions beyond those which are usual.

A **Compound** dislocation is a similar displacement, accompanied with an external wound communicating with the joint.

Dislocations are termed **Complicated,** when accompanied with other unusual lesions than such as characterize them as compound.

The terms **Partial** and **Complete** explain themselves; so also do the terms **Recent** and **Ancient.**

In a **Primitive** luxation the bone remains in the situation into which it was first thrown; whereas in a **Consecutive** dislocation it has assumed a new position.

When a central or median bone, like the inferior maxilla, hyoid bone, sternum, etc., is dislocated upon one side only, the dislocation is called **Unilateral**; when upon both sides, it is called **Bilateral.**

When two corresponding bones upon opposite sides of the body are dislocated at the same points—as, for example, when both shoulders are dislocated—it is called **Double**; when but one is dislocated, it is called **Single**.

A **Traumatic** dislocation is the result of an accident, or of sudden force applied; and a **Pathological** dislocation is the result of disease.

Congenital dislocations are those which were present at the time of birth.

General Causes.

Dislocations occur most often in middle life, not so frequently in old age, and still more rarely in infancy.

Muscular action alone sometimes causes a dislocation; but in nearly all dislocations said to be occasioned by external force, muscular action performs an important part. It is very difficult to produce a dislocation upon the cadaver, when the muscles no longer assist in causing displacement.

In general, the external force which dislocates a long bone is applied to the opposite extremity of the bone. In a few examples it is applied directly to the end dislocated.

General Signs.

In attempting a differential diagnosis between fractures and dislocations, we should take into account the age of the patient, and the manner in which the accident occurred, with any other predisposing or exciting causes which the history of the case may furnish.

The leading differential signs between fractures and dislocations were mentioned when treating of fractures. In dislocations there is an absence of crepitus, there is preternatural immobility of the limb, and when the bones are reduced they usually remain in place. In fractures crepitus is usually present, there is preternatural mobility, and the bones having been reduced, they are in most cases with difficulty retained in place.

General Treatment.

In all cases where the reduction of a dislocation is proper, the reduction should be effected as speedily as possible.

Dislocations are reduced by the employment of such general or constitutional means as diminish the resistance of the muscles, and which thus enable us to employ with more success the local means. Formerly this was accomplished by bleeding, the warm bath, and nauseants. At the present day anæsthetics alone are used.

Dislocations may be reduced also, in many cases, by local, without the aid of constitutional means. The local means are: first, manipulation, or the guidance of the bone to its articulation by certain skilful manœuvres, and without the employment of force, which may be termed the physiological method, since its success depends chiefly upon a knowledge of the functions of the muscles and ligaments; it inflicts less injury than either of the other local measures; it is often successful, and in all recent cases in which it can be applied, should precede the trial of other methods: second, leverage, or the application of force upon the principle of the action of the lever: third, extension, with counter-extension. Both of these latter methods are more or less purely mechanical.

Compound Dislocations.

Compound dislocations are in general more serious than compound fractures, and frequently demand immediate amputation, or resection. The causes of this difference are apparent. The force required to thrust the broad, smooth surface of the articular end of a bone through the flesh is much greater than that required to project the sharp point of a broken bone; consequently the tendons, muscles, ligaments, nerves, and vessels in the vicinity, suffer more strain, contusion, and laceration. It is probable, also, that the exposure of the joint surfaces increases the hazard. Moreover, the fact that when a dislocated bone is reduced it usually remains in place, renders the reduction of a compound dislocation in itself a source of danger; since it brings all these strained and contused tissues into a state of tension, and maintains them in this condition, in spite of the reaction and inflammation which result. We find, therefore, in the overlapping of the fragments, and consequent relaxation and rest to the muscles—which is so inevitable in certain fractures — some compensation for the shortening and deformity of the limbs.

Very many compound dislocations occurring in large joints demand amputation; some are treated successfully by resection and subsequent reduction; in other cases, reduction being at once effected and carefully maintained, recovery takes place with little or no impairment of the function of the joint. A result so favorable is, however, rarely observed except in the case of the phalanges of the hand, and even here it must be regarded as exceptional.

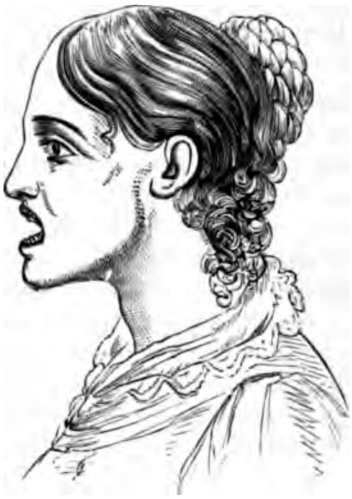
SECTION 2.—SPECIAL DISLOCATIONS.

Dislocations of the Inferior Maxilla.

This dislocation may be unilateral or bilateral; the bilateral being the most frequent. A simple dislocation of the lower jaw can only occur in the direction forwards. If a lateral dislocation should occur, it must be accompanied with a fracture also.

The accident is generally caused by a force applied to the chin when the mouth is wide open. The condyloid process of the inferior maxilla deserts the glenoid fossa of the temporal bone, and slides forwards over the articular eminence into the zygomatic fossa. When both condyles are dislocated, the chin is depressed vertically, and the mouth remains wide open. When only one is dislocated, the chin is also depressed, but at the same time it is thrown a little to the side opposite that on which the dislocation exists.

Fig. 116.



Bilateral Dislocation of Inferior Maxilla.

In case the dislocation is unilateral the surgeon will place a piece of pine wood between the molars to serve as a fulcrum, and lift the chin slowly and forcibly. Sometimes it has been found necessary to press the chin a little backwards at the same time that it was being elevated. When both condyles are dislocated it may be necessary to reduce one condyle at a time, taking care that while reducing the second, the first is not re-luxated.

Dislocations of the Vertebræ.

The bodies of the vertebræ may be displaced more or less completely one from the other; or they may undergo a lateral rotation upon each other, resulting in a fracture or dislocation of the corresponding oblique processes.

The bodies of the vertebræ articulate with each other chiefly through an elastic fibro-cartilaginous tissue, called the intervertebral substance, and not by synovial surfaces, which, when present in other articulations, admit of a gliding motion between the corresponding bony surfaces. It is not in the ordinary sense of the term, therefore, that dislocations occur between the bodies of the vertebræ, inasmuch as there is no slipping of one bone from another, but only a displacement following the fracture or rupture—as it might with equal propriety be termed—of the bond of union between the adjacent vertebræ. In some cases the intervertebral substance is simply detached from one of the vertebræ; in others it is torn more or less obliquely through its centre; but so firm is its connection with the bodies of the vertebræ, that, perhaps, in a majority of cases a portion of one or the other of the vertebræ is broken off and remains attached to the intervertebral substance; and since there is usually no mode of verifying the precise condition, it is proper to conclude that many cases reported as dislocations were quite as much fractures as dislocations, and the reverse.

Moreover, the position of most of the oblique processes is such, that when the bodies of the vertebræ are forcibly separated from each other to any considerable extent, a fracture of these processes can scarcely be avoided. In the dorsal region this would seem to be inevitable. In the cervical and lumbar regions a dislocation of the body of a vertebra is sometimes accompanied with dislocation of the oblique processes also, and not with a fracture.

If the dislocation of the oblique processes is bilateral, it may in general be inferred that there is also a dislocation or a fracture of the corresponding body. If it is unilateral, the intervertebral substance may simply have undergone a lateral rotation.

The differential diagnosis between dislocations of the bodies of the vertebræ and fractures, is, as has been intimated, often exceedingly difficult, sometimes impossible during life. It is not so difficult, however, to determine the existence of a dislocation of one or both of the oblique processes. If but one of these processes is dislocated, as has happened pretty frequently in the cervical region, the head is turned to one side, and fixed in this position: when both are dislocated, the head is thrown back or forwards, and usually fixed in these abnormal positions. The altered positions, also, of the spinous and transverse processes will sometimes facilitate the diagnosis.

Dislocations of the bodies of the vertebræ are accompanied with the same phenomena—relating to the injuries inflicted upon the spinal cord—as accompany fractures of the vertebræ; but in unilateral dislocations of the articulating processes these phenomena are often in a great measure absent.

In most of the cases of dislocations of either the bodies or articulating processes of the vertebræ the patients have died as a consequence of the injury; but Sanson has reported one example of recovery after dislocation of the third cervical vertebra, with no other permanent injury than inability to lift the head more than four inches from the sternum; and Purple has reported a dislocation of the fifth cervical vertebra, followed by permanent paralysis of the lower extremities, in which condition the patient survived seven years. If only one of the oblique processes is dislocated the prognosis is much more favorable.

Attempts at reduction of dislocations of one or both oblique processes, or of the bodies of the vertebræ, have frequently proved unsuccessful. Spencer attempted to reduce a dislocation of the second vertebra, but failed, and his patient died in forty-eight hours. Boyer failed in two cases, and it is said that a young patient at La Charité died while the surgeon was attempting reduction, a few days after the accident. Dupuytren affirms that such attempts are very dangerous, and that he has often known patients to perish while the extension was being made.

On the other hand, Shuck, of Vienna, succeeded in a case of supposed luxation of one of the oblique processes of the cervical vertebræ, and his patient made a complete recovery. Extension, in this case, was made from the chin and occiput, and counter-extension from the shoulders. The force was gradually increased, until a sudden snap was felt, and immediately the head was restored to its natural position and power of motion.

Hickerman, of Ohio, found in the case of a girl one of the vertebræ dislocated, causing a prominence in the back part of the pharynx, opposite the fourth and fifth cervical vertebræ, and almost completely suspending respiration and the action of the heart. He seized the head of the patient under his left arm and thus made extension, while with the index finger of his right hand he made pressure upon the projection in the pharynx. In about one minute the bone receded under the pressure, and immediately the respiration became natural. Her recovery was complete.

Schauth succeeded on the eighth day, in what was probably a dislocation of one of the oblique processes of the fourth cervical vertebra, by extension and counter-extension made from the head and shoulders by four men. During the extension the head was also rotated slightly, and pressure was made directly upon the transverse process. The reduction of the bone was accompanied with a sound, loud enough to be heard distinctly.

Maxson, of Geneva, N. Y., relates the case of a girl, about nine years of age, having a dislocation of the right oblique process of the fifth or sixth cervical vertebra, caused by turning her head suddenly around while at play. At first she complained only of inability to straighten the neck, and she became faint whenever she was moved. About forty-eight hours after the accident her mother attempted to turn her head slightly, when a severe convulsion ensued. Dr. Maxson saw her soon after, and could feel distinctly the displacement of the transverse process. He grasped her head with both hands, and turned it gently in the same direction to which it was already inclined, namely toward the left shoulder, in order if possible to disengage the process; then lifting, or extending the head, he rotated it carefully in the opposite direction, when reduction was accomplished. Her recovery was speedy and complete. Wood of this city, Rust, and others, have met with like success in similar examples.

Ayres, of Brooklyn, has furnished us with a successful reduction on the ninth day of a bilateral dislocation of the oblique processes. The patient was a man thirty years of age, and the di location occurred in some manner unknown, while he was in a state of intoxication. Reduction was effected by extension and counter-extension, while the patient was under the influence of chloroform. The extension was made in a direction upwards and backwards, by the hands of three surgeons applied to the chin and occiput, while counter-extension was made by two folded sheets crossed upon the shoulders.

Dislocations of the atlas from the axis, and of the head from the atlas, have generally proved speedily fatal. The elder Malgaigne succeeded, however, in reducing a dislocation of the atlas forwards, and Ehrlich reduced a dislocation of the same bone backwards; while Dariste exhibited to the Anatomical Society of Paris, 1838, a specimen of incomplete luxation of the head upon the atlas, which accident the patient had survived more than a year.

Dislocations of the Ribs.

No doubt the ribs may be dislocated from the vertebræ; but inasmuch as it is scarcely possible that such accidents should be recognized during life, and as it would be quite impossible to accomplish a reduction if recognized, these accidents have but little claim to any further notice.

The cartilage of the first rib is united directly to the sternum and corresponding rib; but the remaining six upper cartilages have proper articulations at their sternal extremities, unless these articulations have become lost by age, and they are occasionally subject to dislocation. In general the dislocation is easily recognized, and is without difficulty reduced; it has not been found, however, that it could be so easily retained in place. A compress and bandage constitute the only appliances for maintaining reduction.

The cartilages of the sixth, seventh, and eighth ribs articulate with the corresponding cartilages below, and sometimes the fifth and ninth have similar articulations. They may be dislocated by a fall upon the back, in which case the lower rib glides under or behind the upper. By pressure made against the lower margin of the upper rib, in a direction upwards and backwards, aided by a full inspiration, they can be caused to resume their places; and when reduced they are not very prone to re-luxation.

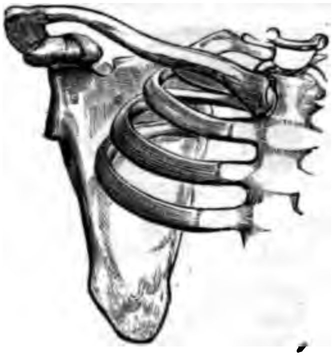
Dislocations of the Clavicle.

Dislocations of the clavicle, whether at the sternal or acromial end, are generally caused by falls upon the shoulder. Of 57 dislocations of the clavicle observed by me, 13 belonged to the sternal, and 44 to the acromial end.

Dislocations at the sternal end may occur in three directions, namely, forward upon the sternum, upwards, and backwards. The two first of these varieties are in general easily reduced, but to maintain the reduction is, in most cases, impossible. The apparatus recommended by Sir Astley Cooper will perhaps answer the indications as fully as any which can be devised; but even when aided by a compress placed over the sternal end, secured by bandages, I have never seen it kept in place.

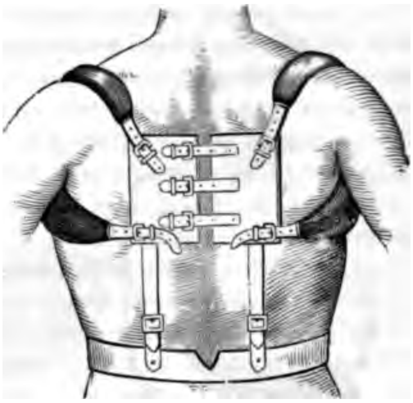
I have once seen the sternal end dislocated upwards as high as the thyroid cartilage; and, notwithstanding the utmost pains were taken to reduce it and maintain it in place, the bone remained elevated about half an inch above the sternum.

Fig. 117.



Dislocation of the Sternal End of the Clavicle forwards.

Fig. 118.



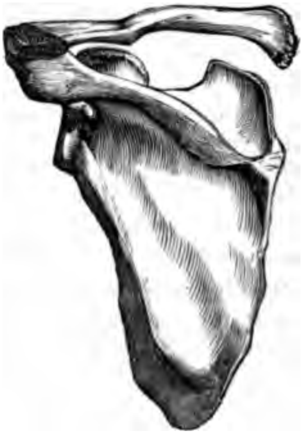
Sir Astley Cooper's Apparatus for Dislocated Clavicle.

The dislocation backwards has sometimes caused serious difficulty in respiration and deglutition. Its reduction has been found difficult, but when reduced it is less likely to become displaced than either of the other two forms. The patient must be laid on his back, with a firm pillow between the shoulders, and the arm should be slightly elevated and confined to the side of the body.

The outer or acromial end of the clavicle is not unfrequently dislocated upwards, and more rarely it is driven fairly over the acromion process, constituting a dislocation upwards and outwards.

This dislocation is easily reduced, but the clavicle is with difficulty retained in place. The treatment consists in the application of a force over the top and outer end of the clavicle, with a counter-force applied below the elbow so as to elevate the humerus and scapula; while the arm and forearm are confined by a sling and bandage against the side and front of the body. These indications will be fulfilled by an ordinary sling, a bandage passed over the top of the clavicle and under the elbow, and a roller enclosing the arm and body. Wherever the successive turns of the roller cross each other, they must be carefully stitched together; and in order to accomplish the best results, it must be tightened daily by overstitching.

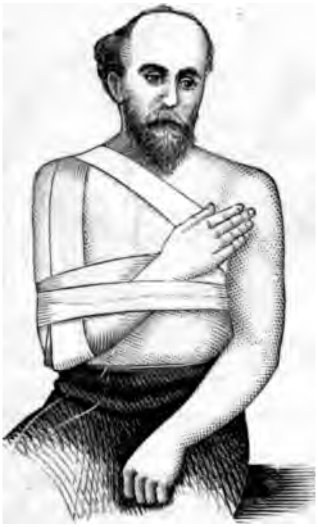
Fig. 119.



Dislocation of the Acromial End of the Clavicle upwards and outwards.

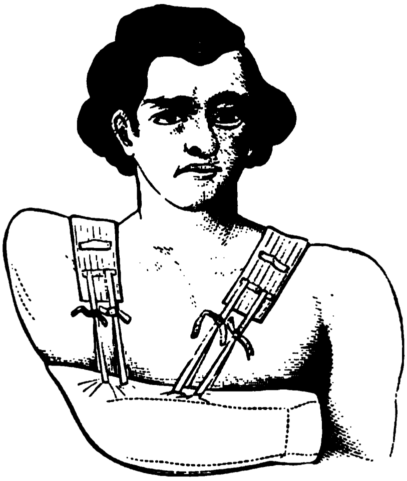
Mayor employed only a sling constructed in the manner represented in the accompanying drawing.

Fig. 120.



Author's dressing for Dislocation of Clavicle at its Acromial Extremity.

Fig. 121.



Mayor's Apparatus for the same.

Five cases have been recorded of dislocation of the outer end of the clavicle downwards, under the acromion process. In two of these reduction was easily effected by drawing the shoulder outwards and backwards.

Two surgeons pretend to have seen a dislocation of the clavicle under the coracoid process; but I doubt whether the accident has ever occurred, because I think it impossible.

A simultaneous dislocation of the clavicle at both extremities occurring in a boy fourteen years old, and which was easily reduced and retained in place, has been reported by Dr. North, of Brooklyn.[1]

Dislocations of the Humerus.

The head of the humerus is liable to dislocation in three directions, namely, downwards, forwards, and backwards; and these several forms have been named respectively subglenoid, subcoracoid and subspinous. In certain cases, also, the head of the humerus passes still farther forwards, and rests in front of the coracoid process, beneath the clavicle; this variety of the forward luxation is called subclavicular.

Both partial and complete luxations of the humerus, depending upon pathological causes, are not uncommon. Thus, for example, we often meet with partial or complete luxations of the shoulder caused by muscular or arthritic rheumatism, and by various other diseased conditions of the muscles or of the joint itself; but I have seen no evidence that a *traumatic partial* luxation ever takes place in this articulation.

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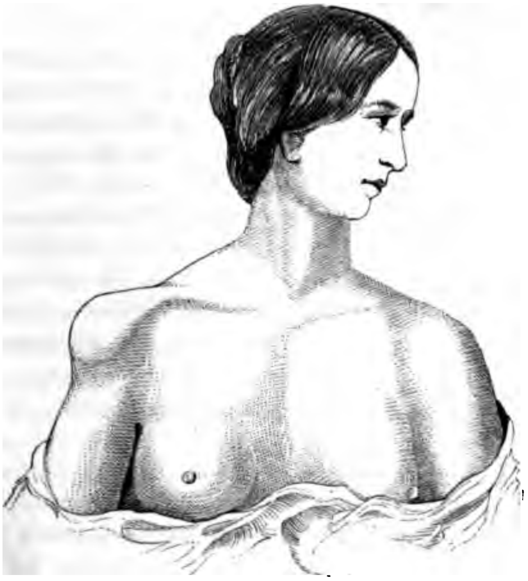
[1] North. *New York Med. Record*, April 16, 1866.

Subglenoid Dislocations, or Dislocations Downwards into the Axilla, may be caused by a force operating against the lower end of the humerus, or against the hand, when the arm is carried away from the body; by a force which shall pull the arm upwards over the head, or by a blow received directly upon the upper and outer end of the bone.

Fig. 122.

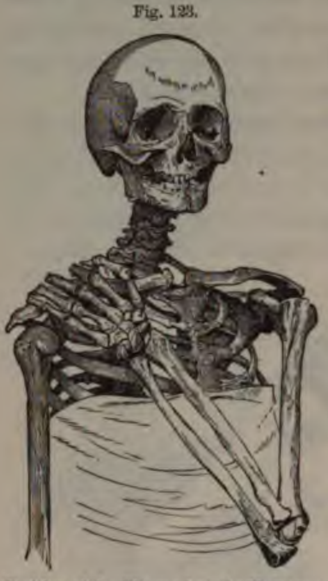


Subglenoid Dislocation of the Humerus.

A fracture of the surgical neck is very often mistaken for a dislocation of the head of the humerus, and for this reason it will be proper to enumerate carefully all the absolute and differential signs.

First, there is generally, in the case of a subglenoid dislocation, a depression under the acromion process: second, in some cases the head of the humerus can be felt in the axilla: third, the elbow hangs a little from the side of body: fourth, the line of the axis of the shaft of the humerus is directed toward the axilla and not toward the glenoid cavity: fifth, in many cases the arm and hand are numb or painful, from pressure upon the axillary plexus. The remaining signs are differential, namely: sixth, in the case of a dislocation, absence of crepitus: seventh, in the same case, preternatural immobility: eighth, it is proper to add, as a differential sign, that if the patient is very old it is probably a fracture; finally, Dugas' posture test will seldom if ever leave us

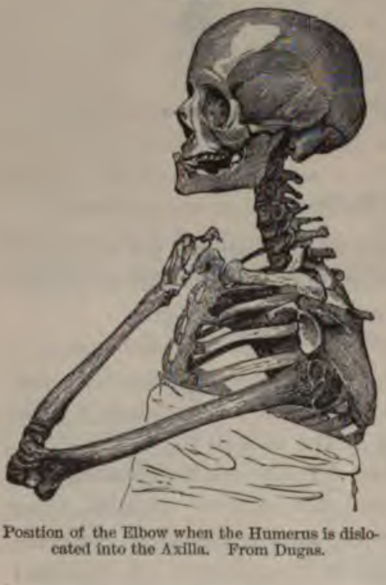
Fig. 123.



Position of the Elbow when the Humerus is not Dislocated. From Dugas.

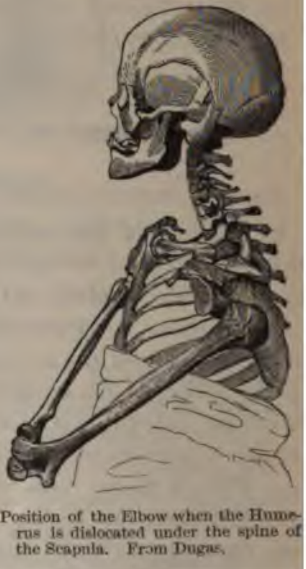
in doubt.[1] When the humerus is dislocated, whether it be downwards, forwards or backwards, the head, having left the glenoid cavity, falls against the side of the body; and since the chest is round or elliptical in form, while the humerus is straight, it follows that if the hand of the dislocated arm is placed upon the opposite shoulder, the elbow will project, or, in other words, recede from the front of the chest. While, on the other hand, if there is no dislocation, it will not thus recede. Neither a contusion nor a fracture can create the mechanical impediment which exists in this case. It may be, indeed, that, in a case of contusion or fracture, the pain, and consequent muscular contraction, occasioned by placing the arm in this position might offer some obstacle to the easy repose of the elbow upon the chest; but then, if the patient is placed completely under the influence of an anæsthetic, this obstacle, which is purely physiological, and not mechanical, will be at once removed.

Fig. 124.



Position of the Elbow when the Humerus is dislocated into the Axilla. From Dugas.

Fig. 125.



Position of the Elbow when the Humerus is dislocated under the spine of the Scapula. From Dugas.

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[1] Dugas. Report on a New Principle of Diagnosis in Dislocations of the Shoulder-joint; by L. A. Dugas, M.D., Prof. of Surgery in the Medical College of Georgia. *Trans. Amer. Med. Assoc.*, vol. x., 1857, p. 175.

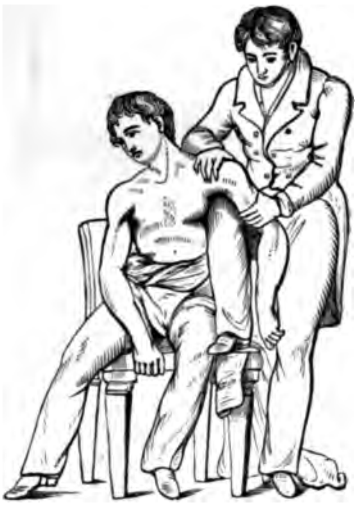
I regard this means of diagnosis as infallible; at least it has always proved to be so in my hands; and I am surprised that the writers of surgical treatises both at home and abroad have paid so little attention to it.

The reduction of a recent subglenoid dislocation is, in most cases, easily effected. In a few cases, however, it has been found to be very difficult. The methods which deserve a trial present themselves in the following order:—

First, the forearm should be flexed upon the arm, and while the arm is elevated to a right angle with the body it should be rotated gently forwards by depressing the hand and forearm. This is a method of simple manipulation, and ought to be first tried, since it is often successful.

Second, the same method, with the addition of the knee in the axilla to press the head of the humerus outwards, or to serve as a fulcrum upon which the humerus may act as a lever. This is essentially one of the methods recommended by Sir Astley Cooper.

Fig. 126.



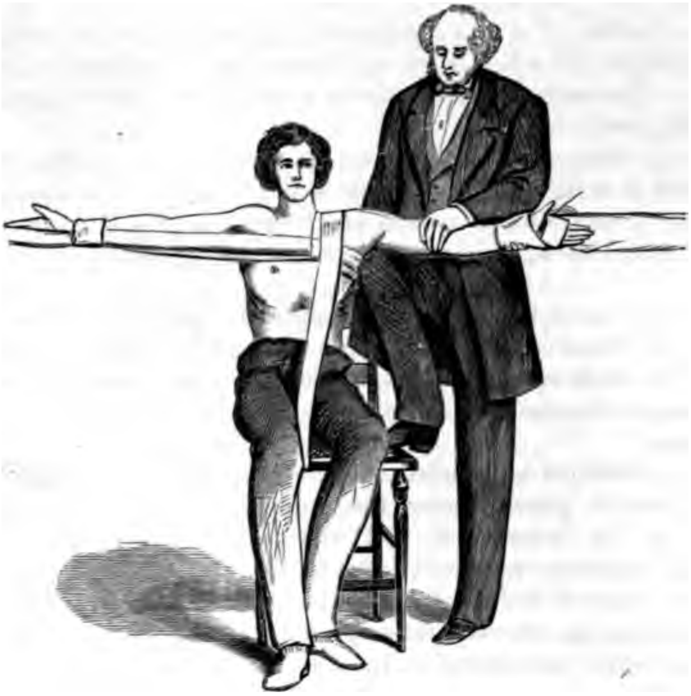
Sir Astley Cooper's Method, with the Knee in the Axilla.

If these attempts have failed, the patient should be placed under the influence of an anæsthetic, and the preceding methods repeated; and in case of continued failure, the patient still remaining anæsthetized, the surgeon will adopt other procedures, in the following order:—

Third, with his heel in the axilla the surgeon will draw the arm of the patient steadily downwards, parallel with the side of the body. By this procedure we do not effect reduction by the extension and counter-extension, but chiefly or solely by the action of the heel as a wedge, or by the combined action of the heel and humerus as a fulcrum and lever. Sir Astley employed for this purpose a lacque applied to the lower end of the humerus, but the hands of the surgeon, seizing upon the hand and wrist of the patient, are equally effective.

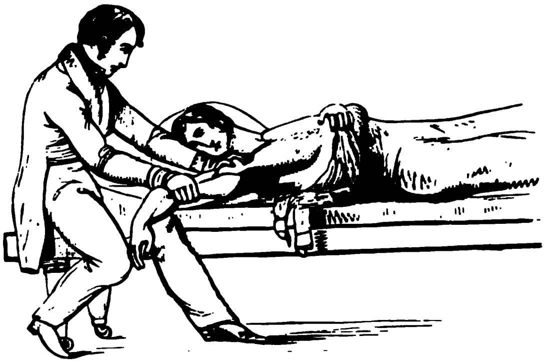
Fourth, extension and counter-extension after the manner recommended by Nathan R. Smith. Smith proposed to make the counter-extension by the opposite arm, while both arms were in a position at right angles with the body. The connection established between the two scapulæ through the trapezii, enables the surgeon by pulling at the sound arm to render the counter-extension effective upon the scapula of the dislocated arm. I have succeeded by this plan, aided only by one assistant, who grasped the hand of the sound arm and made counter-extension, while I made extension in the same manner from the opposite hand. Smith, however, employed also lateral and vertical bands, as seen in the preceding wood-cut; while the knee resting in the axilla served as a fulcrum upon which the humerus might be operated as a lever.

Fig. 127.



Nathan R. Smith's Method.

Fig. 128.

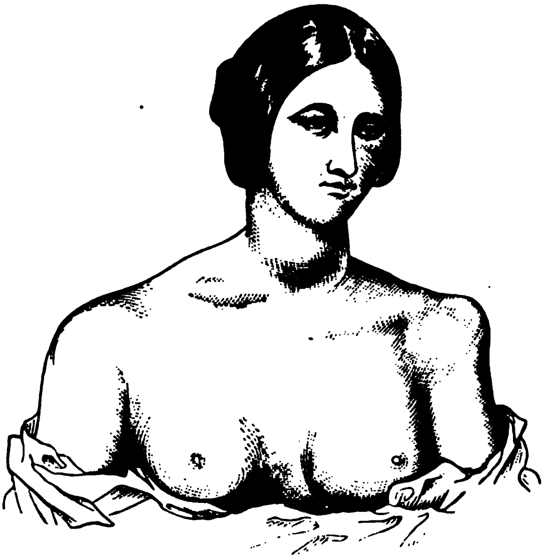


Vertical Extension.

Fifth, extension and counter-extension by pulling the arm directly upwards, while the hand or the foot of the surgeon is placed upon the top of the shoulder. This method is more liable to extensively lacerate the capsule, and probably exposes the axillary artery to the danger of being ruptured more than any other. It ought to be held, therefore, as a last resort, especially in the case of old dislocations.

Subcoracoid, or the First Variety of the Forward Dislocations, are occasioned by accidents very similar to those which cause subglenoid dislocations. They are characterized also by similar phenomena, but the elbow generally hangs a little farther back, and the head of the bone may often be felt under the coracoid process.

Fig. 129.



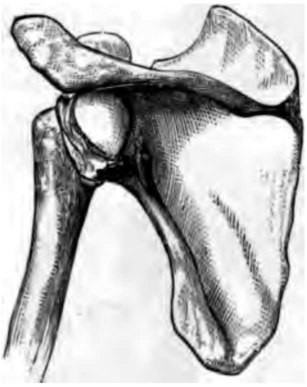
Subcoracoid Dislocation.

The principles of treatment are precisely the same as those already indicated for subglenoid dislocations.

Subclavicular, or the Second Variety of the Forward Dislocations are rare. They are only exaggerations of the subcoracoid, and are easily recognized by the presence of the head of the humerus under the clavicle. Their reduction demands sufficient extension to disengage the head and neck of the humerus from under the conjoined tendons of the coraco-brachialis and biceps; and this having been accomplished, the remaining steps are the same as in subglenoid dislocations.

Subspinous Dislocations, or Dislocations Backwards, upon the Dorsum of the Scapula, and Beneath its Spine.—Of all the forms of shoulder dislocations this is the most unfrequent. In general it has been easily recognized, and in most of the cases reported, it has been easily reduced. In a case seen by myself the accident was caused by the arm being caught in machinery, and it was promptly reduced by making extension in a direction outwards and downwards.

Fig. 130.

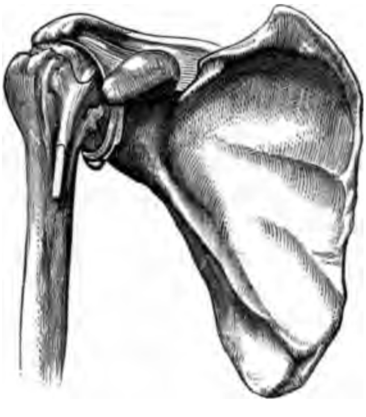


Subspinous Dislocation.

Displacement of the Long Head of the Biceps.

Displacement of the long head of the biceps is characterized by a sudden inability to move the limb with freedom, by pain, and by a slight advance of the head of the humerus in its socket. I think I have seen one case of this kind, in which the tendon resumed its position spontaneously after the lapse of several days. Other similar cases have been reported.

Fig. 131.



Displacement of the Long Head of the Biceps.

Dislocations of the Shoulder, with Fracture of the Humerus.

Dislocations of the shoulder, accompanied with a fracture of the humerus near its upper end, are exceedingly difficult to manage. Sometimes, under the influence of an anæsthetic, the head of the bone may be pushed into its socket. If this fails, the only alternative is to secure union of the broken bone, and, after the lapse of six or eight weeks, to endeavor to reduce the dislocation.

Ancient Dislocations of the Shoulder.

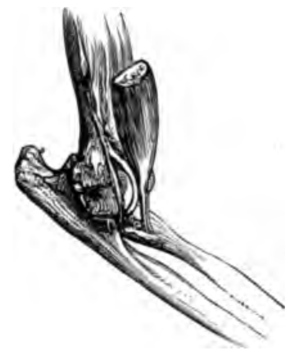
Ancient dislocations of the shoulder are occasionally reduced after much manipulation, and extension made by the hands or by pulleys. If eight or ten weeks have elapsed the chance of success is not very great; yet I have succeeded as late as eight weeks, and others at a much later period. On the other hand, a number of cases have been recorded in which the axillary artery or vein has been ruptured while the attempt at reduction was being made; in others abscesses have been occasioned, or the neck of the humerus has been broken. This latter accident happened to myself in the case of an old lady in whom I attempted reduction after the lapse of six weeks.

Dislocations of the Radius and Ulna.

These two bones may be dislocated conjointly at their upper extremities in four directions; namely, backwards, inwards, outwards, and forwards. The two lateral luxations are generally incomplete.

Dislocations of the Radius and Ulna Backwards.—Caused in most cases by a fall upon the hand, but occasionally by a blow upon the back of the arm, or by a twist of the elbow. In this dislocation the forearm is usually slightly flexed upon the arm, and pronated. The radius is felt to have deserted its articulation, and the olecranon projects posteriorly. Sometimes the lower end of the humerus can be felt in front.

Fig. 132.

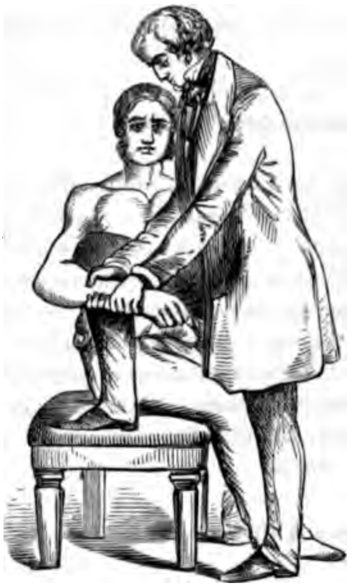


Dislocation of the Radius and Ulna backwards.

It is very often mistaken for a fracture of the lower end of the humerus above its condyles. The differential signs are those which usually distinguish fractures from dislocations; to which may be added the following two special signs:—

First, in dislocation, the humerus is never shortened; while in the fracture it is almost invariably. In order to determine the length of the humerus, measurement can be made from either condyle to the acromion process. Second, if, in case of a dislocation, the forearm forcibly straightened upon the arm, the projection of the olecran process will be slightly, yet sensibly, diminished. The reverse w generally happen if it is a fracture.

Fig. 133.



Reduction with the Knee in the Bend of the Elbow.

It is worthy of note, also, that in t dislocation, while there exists mark immobility in the direction of flex and extension, there is unnatural late mobility, which is even greater tl that which is usually present in fractu

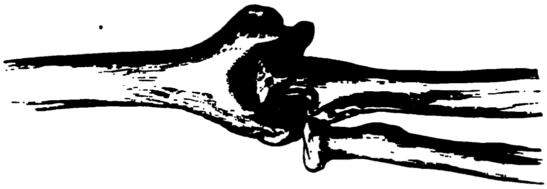
Reduction may be accomplished placing the knee in the bend of elbow, and flexing the forearm, wl extension is made from the hand, wrist.

I have sometimes succeeded, also, seizing the hand and drawing the wl limb backwards and outwards, a right angle with the body. By method we relax the triceps; while the other we relax the brachialis anti and biceps.

When the dislocation is ancien have sometimes found it necessary divide the triceps, or, by forced flex to break the olecranon process. special injury to the arm has ens from either of these procedures.

Lateral Luxations of both Radius and Ulna.—These dislocat are nearly always incomplete; and the extent to which the displ ment occurs has been found to vary in different cases. In general t are easily recognized by the unnatural projection, upon one or l sides, of the bones which enter into the formation of the articulat

Fig. 134.



Most frequent form of incomplete Outward Dislocation of the Forearm.

There is also present in all of these cases a preternatural lateral m lity, such as has been mentioned when speaking of the complete location backwards of both bones.

Forward Dislocations of Radius and Ulna.—At least nine cases of this extraordinary luxation, unaccompanied with fracture, have now been reported; and several other cases of subluxation in the same direction. The reduction will be best accomplished by forced flexion of the forearm, aided by pressure. In some of the cases extension alone has succeeded.

Dislocations of the Radius.

Dislocations of the Head of the Radius.—The upper extremity of the radius may be dislocated forwards, outwards, or backwards. Of these, the dislocation forwards is by far the most frequent. A subluxation forwards, also, sometimes occurs as a consequence of a stretching of the orbicular ligament; in most cases this has been caused by lifting a child by one arm.

The head of the radius is so superficial, that a careful examination ought to determine its absence from its natural position, unless indeed the arm is much swollen; yet these accidents are very often overlooked. Under the subject of amputations at the elbow-joint, I have given very special directions as to the mode of finding the upper end of this bone.

The head of the radius may be reduced, when dislocated forwards, by extension made from the hand, while pressure is made upon the head of the radius towards the socket. In making extension the forearm should be inclined to the ulnar side. After reduction it must be maintained in place by a pad and bandage.

In either of the other dislocations extension, aided by pressure made in the proper direction, will generally succeed.

Dislocations of the Radius at its Lower End.—The radius alone, of the bones of the forearm, articulates directly with the carpal bones. Its dislocation constitutes, therefore, properly speaking, a dislocation of the wrist-joint, and it may take place in a direction either forwards or backwards.

I have once met with what I believed to be a simple, uncomplicated dislocation of the radius forwards at this articulation. Dupuytren never saw a case which was clearly a dislocation, and he entertained a doubt whether it ever did occur; it is certainly very rare, and of the reported cases it is probable that some of them were examples of a Barton's or of a Colles' fracture, both of which the forward luxation so much resembles.

Dislocations of the Ulna.

Dislocations of the Lower End of the Ulna from the Radius may occur in either a forward or backward direction. In either case the reduction is accomplished by pressing forcibly upon the projecting bone, after which it must be maintained in place by a compress and bandage.

Dislocations of the upper end of the Ulna.—It is probable that the ulna may be dislocated without the radius, backwards or even inwards; but if these accidents occur they are so rare as scarcely to demand in this place special consideration.

Dislocations of the Bones of the Hand.

Dislocations of the Carpal Bones.—The semilunar, cuneiform, pisiform, and magnum have been occasionally found either partially or completely luxated. These luxations were caused in some cases by simple relaxation of the ligaments, in others by falls upon the hand when the fingers were flexed, or, as in the case of the pisiform, by muscular action alone.

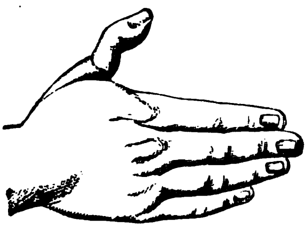
If these bones cannot be reduced by moderate pressure, it will be better to permit them to remain unreduced. After reduction compresses and bandages are required to retain them in place.

Maisonneuve has reported an example of dislocation through the *middle carpal* articulation, which he saw in the dissecting-room, and which had not been reduced during life, but which was reduced after death by slight traction.

Carpo-Metacarpal Dislocations.—Examples have been reported of both forward and backward luxation of the metacarpal bones of the thumb, of the first and of the second fingers. The dislocation backwards is the most frequent. They have been caused by direct blows, or by blows upon the distal extremities of the bones. In two cases I have found a partial luxation backwards of the metacarpal bones of the first and second fingers, caused by striking upon the knuckles with the clenched fist. By extension, with pressure, they are in general easily reduced; but they require to be kept in place by some suitable support for a certain length of time.

Dislocations of the Phalanges of the Hands.—All of the phalanges are liable to be dislocated; but the only one which has occasioned the surgeon much embarrassment, is the dislocation of the first phalanx of the thumb upon its metacarpal bone. This latter dislocation may take place in any direction, but it is usually either backwards or forwards.

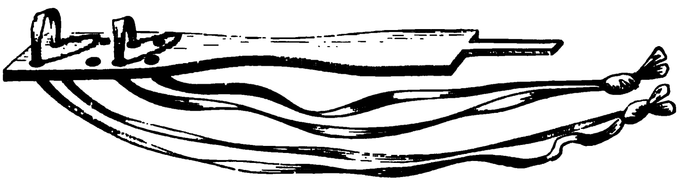
Fig. 135.



Dislocation of the First Phalanx of the Thumb backwards.

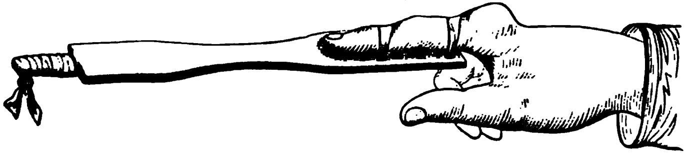
The character of the accident being recognized, the patient should be placed at once under the influence of ether, and extension first made by the hand of the surgeon, aided by pressure upon the projecting bone. In case this does not succeed, and if it be a dislocation of the first phalanx backwards upon the metacarpal bone, the thumb must be seized and carried over toward the back of the wrist, while pressure is made upon the back of the phalanx near its proximal end. If it is a forward luxation, the manœuvre must be reversed, that is, the phalanx must be pressed towards the palm of the hand into a position of forced flexion, while pressure is made upon the proximal end of the phalanx in an opposite direction. If now the thumb be suddenly extended, reduction will often be accomplished.

Fig. 136.



Levis' instrument for reducing Dislocations of the Thumb and Fingers.

Fig. 137.



Levis' instrument applied.

The ingenious apparatus invented by Dr. Richard J. Levis, of Philadelphia, for combining extension with leverage, will also deserve a trial.

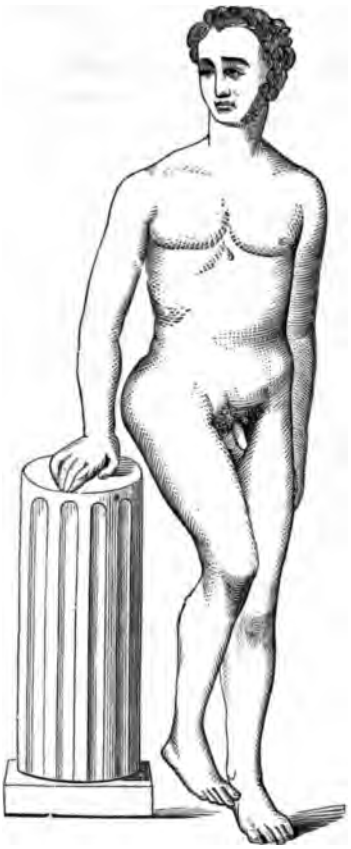
When all other methods have failed, the surgeon should not hesitate to divide the lateral ligaments; and if this were to fail, the flexor muscles ought to be divided rather than to leave the bone unreduced. I have cut one or both of the lateral ligaments in these cases, and with uniform success.

If the dislocation is compound and not easily reducible, resection should be practised.

Dislocations of the Femur.

The thigh may be dislocated upwards and backwards upon the dorsum of the ilium; upwards and backwards into the ischiatic notch; upwards and forwards upon the pubes; and downwards and forwards upon the obturator foramen.

Fig. 138.



Dislocation upon the Dorsum Ilii.

Dislocations upon the Dorsum Ilii are caused generally by a force applied to the lower end of the femur, when the limb is more or less adducted, or by a weight descending upon the back when the body is bent and the leg a little inclined inwards.

The limb will be found in this dislocation shortened, rotated inwards, adducted and slightly flexed. The trochanter major will be less prominent than upon the opposite side; and sometimes the head of the femur may be distinctly felt upon the dorsum of the ilium; especially when an attempt is made to rotate the limb.

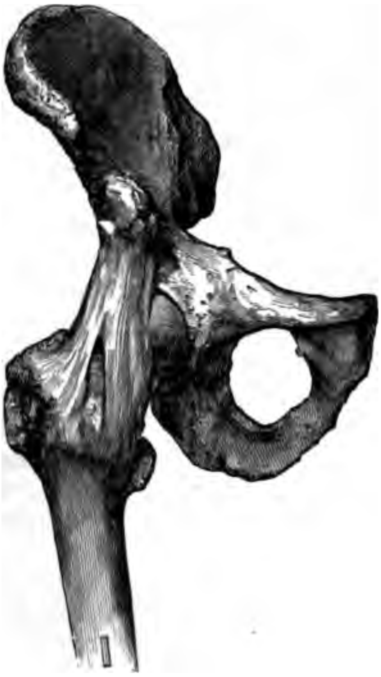
Differential Signs between Fractures of the Neck of the Femur, and Dislocations upon the Dorsum Ilii.

DISLOCATIONS UPON THE DORSUM ILII.	FRACTURES OF THE NECK OF THE FEMUR.
1. Very rare in advanced life.	1. Very frequent in advanced life.
2. Never caused by a fall upon the trochanter major.	2. Often caused by a fall upon the trochanter major.
3. Absence of crepitus.	3. Crepitus.
4. Preternatural immobility.	4. Limb can be moved freely except when the motion causes pain.
5. Limb always shortened.	5. Limb not always shortened.
6. Limb almost always rotated inwards, adducted and flexed.	6. Limb seldom in this position; almost always slightly rotated outwards, and generally lying parallel with the other limb.

Surgeons have not hitherto been fully agreed as to the sources of the difficulty which is occasionally experienced in the reduction of this and other dislocations of the head of the femur, some having maintained that it was to be sought exclusively in the resistance offered by the muscles, and others that it was to be found in the untorn portions of the capsule with its accompanying ligaments. We are especially indebted in this country to the writings and experiments of Drs. Gunn, of Chicago, and Bigelow, of Boston, for having demonstrated that in a large proportion of cases the position of the dislocated bone is determined by the relations of the head and neck with the untorn ligaments. This is believed to be especially true in reference to the dislocation now under consideration.

Treatment.—If the dislocation is recent it is advisable to first make an attempt to reduce the dislocation by manipulation, and without resort to anæsthetics. It is quite probable that in the reduction by manipulation the action of certain muscles aids in the replacement of the bone; but whether this is so or not, we certainly incur less danger of lacerating tissues, or of fracturing the neck of the femur, when the patient remains fully conscious; and the number of accidents of this kind which I have myself seen, in addition to the number reported by others, permit no one to question their possibility, and the propriety of considering by what means they can be most certainly avoided.

Fig. 139.



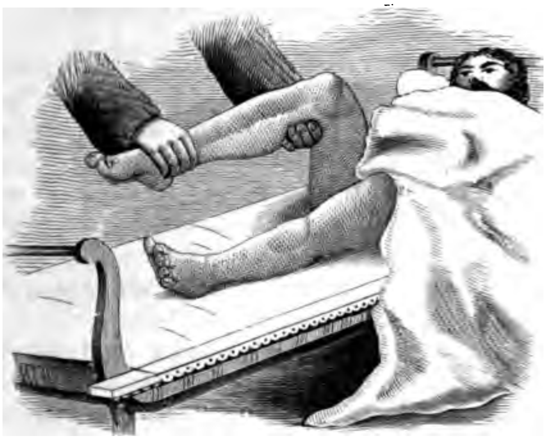
Ilio-Femoral Ligament in its Natural Position.
Bigelow.

In case manipulation without anæsthesia fails, the surgeon will at once employ an anæsthetic and proceed to repeat the manipulation.

First, the patient resting upon his back, the surgeon, in the case of the right thigh, seizing the knee with his left hand and the ankle with his right, flexes the leg to a right angle with the thigh, for the purpose of enabling him to rotate, and otherwise manipulate the limb with greater ease.

Second, the thigh is flexed to about a right angle with the body. Reid, of Rochester, and a few other surgeons have taught that the thigh should be flexed until the knee touches the belly; but this cannot be accomplished, in most cases, without the employment of immoderate force, such force, indeed, as will endanger the neck of the femur, or cause unnecessary laceration of the tissues adjacent. Moreover, I have not found it necessary to flex the limb to this degree, except in old dislocations, where sometimes it becomes necessary, at

Fig. 140.

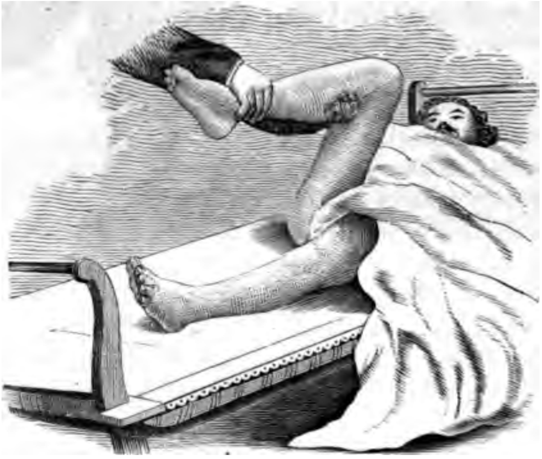


First Position in the Method of Reduction by Manipulation.

the risk of accidents, to lacerate the capsule and the adventitious structures extensively. There is another objection to this extreme flexion which my own experience, and the experience of others, has demonstrated; namely, that it is possible, in this way, to carry the head of the bone into the ischiatic notch, and even around the lower edge of the acetabulum into the foramen thyroideum.

Usually when the thigh is flexed to a right angle, or nearly to a right angle, its progress in this direction is somewhat suddenly arrested; and this point of resistance determines, in my opinion, the necessity of changing the direction. The head of the bone has now descended on the dorsum of the ilium, and is resting against the abrupt inclined plane near the upper and outer margin of the acetabulum, ready, at the next step of the manipulation, to mount this plane and enter the socket.

Fig. 141.

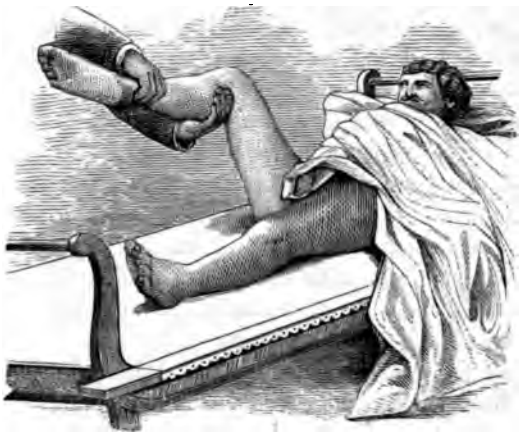


Second Position in the Method of Reduction by Manipulation

In flexing the thigh upon the abdomen the limb remains adducted, and it is impossible to carry it up abducted; yet the instructions given by Nathan Smith to press slightly against the inner side of the knee, so as to cause partial abduction, is judicious, since by this procedure the head of the femur is made to approach the acetabulum. There is nothing gained by forcible abduction while making the flexion, except in old cases where it is desired to cause laceration; on the contrary, in recent cases it diminishes the chance of success.

Third, the thigh is abducted, and rotated outwards. It is a fact worthy of being mentioned, that both the abduction and the outward rotation often take place spontaneously when the thigh is flexed to a right angle, or, as it was very aptly expressed by one of the old surgeons, "a self-twisting of the thigh" occurs, "which cannot be prevented by fast holding." This "self-twisting" and outward inclination must be favored by the surgeon; indeed, it is proper now to use some force in order to increase the abduction, so that the head of the bone may be made to rise over the margin of the acetabulum; I think I have seen this favored by lifting the knee, that is, by drawing the limb up, nearly at a right angle with the body; and its entrance into the socket has been still farther encouraged by giving to the limb a slight oscillatory motion, as suggested by Dr. Nathan Smith.

Fig. 142.



Third Position in the Reduction by Manipulation.

It frequently happens that the reduction is effected while the limb is in this third position; but Markoe and myself have noticed that in most cases the bone falls into the socket when, the abduction and outward rotation being still maintained, the limb is beginning to descend towards the extended position.

If manipulation fails, the surgeon must resort to the method by extension: first, with the thigh at a right angle with the body, the patient resting upon his back, and the pulleys being attached to some point directly above, a method which is especially recommended by Bigelow: second, in case of a failure by this method, extension may be applied in the direction of the axis of the limb as it was originally found, and as recommended by Sir Astley Cooper.

Dislocation Upwards and Backwards into the Ischiatic Notch.—In order that this accident may occur, the thigh must be more flexed upon the abdomen than in the case of the dislocation upon the dorsum. In other respects the mechanism of its causation is the same.

The position which the limb assumes is also nearly the same as in the preceding dislocation, except that the thigh generally remains a little more flexed, while the adduction and rotation inwards are not so decided. The head of the bone can sometimes be felt under the nates; and a finger introduced into the rectum or vagina may disclose the presence of the head of the bone in the ischiatic notch.

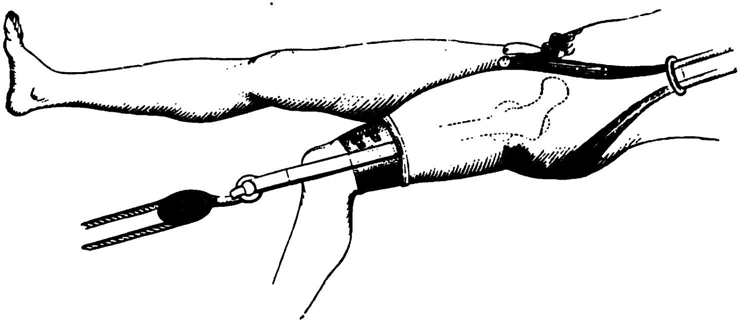
Dr. Bigelow speaks of a "dorsal" dislocation as sometimes occupying a position as low as the upper edge of the ischiatic notch; but the dislocation now under consideration he describes as that in which the head of the femur having been driven from its socket downwards and backwards, is subsequently, in the attempt to straighten the limb, carried upwards behind the socket until it is arrested by the strong tendon of the obturator internus, and the subjacent untorn capsule. In some cases, also, the head passes behind the tendon. Both of these forms of ischiatic dislocation, in which the head of the femur is arrested in its ascent by the tendon of the obturator internus, are called by Dr. Bigelow "dorsal, below the tendon."

Its reduction is effected by the same manipulation which has already been described for dislocation upon the dorsum. If, during the manipulation, the thigh is very much flexed upon the abdomen, there is great danger that the head of the femur will be carried around the lower margin of the acetabulum into the foramen thyroideum. This has happened to me twice, but with no serious results, the head of the bone being easily carried back by reversing the manipulation.

This dislocation may also be reduced by extension applied in the same manner as for dislocation upon the dorsum, only that the thigh must be more flexed while the extension is being made.

Dislocation upon the Pubes, less frequent than either of the other forms of hip-joint dislocation, is generally caused by a fall upon the foot when the pelvis and belly are thrown forwards. The leg is generally shortened, abducted slightly, and rotated outwards, and the head or neck of the femur may be felt over the horizontal ramus of the pubes.

Fig. 143.



Reduction of Dislocation upon the Pubes, by Extension.

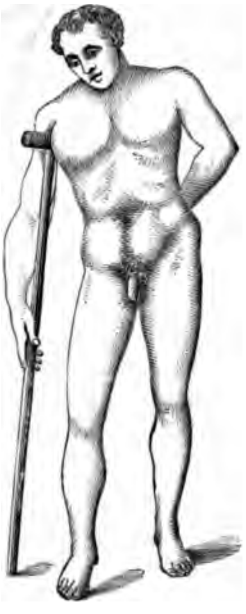
If the head of the femur has fairly traversed the pubes, so that it rests over the pelvic cavity, while the neck rests upon the pubes, extension must precede manipulation, or if manipulation is at once employed, the first step will be to rotate the thigh outwards and abduct it very forcibly so as to throw the head upon the pubes; after which forced flexion, adduction, and finally rotation inwards, will carry the head into the acetabulum. In case the head rests upon the pubes, the first step of the process just described may be omitted. Extension employed alone has sometimes succeeded.

Dislocation into the Foramen Thyroideum.—Caused generally by a forced abduction of the thigh, or by a weight received upon the back of the pelvis while the body is bent and the thigh abducted.

The limb is found abducted, somewhat flexed upon the body, and rotated outwards. The position of the limb being very nearly the same as in the first stage of morbus coxæ; it is also lengthened from one to two inches. By introducing the finger into the rectum or vagina, we may feel the rotation of the head of the femur in its new position. We must take care, however, not to mistake a sensation caused by the action of the muscles in rotating the limb, for the sensation caused by the movements of the head of the bone. This point of diagnosis will be verified by carrying the finger consecutively from one thyroid foramen to the other, while the respective limbs are rotated.

Reduction may be accomplished by manipulation, the procedure being precisely the reverse of that employed in dislocations upon the dorsum; that is to say, by flexing the thigh to a right angle with the body, then adducting and rotating inwards.

Fig. 144.

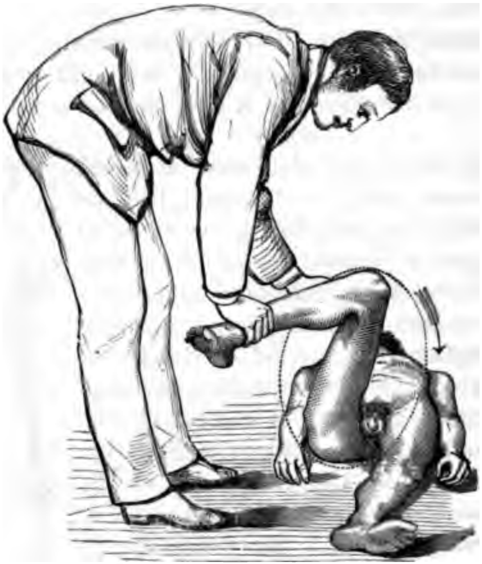


Dislocation into the Foramen Thyroideum.

In most cases, however, the dislocation has been reduced by a method of leverage and lifting; that which I prefer being as follows: The patient resting upon his back, a sheet is passed around the pelvis, and its two ends committed to assistants standing on the side opposite the dislocated limb. A second assistant passes his hand under the sound leg, and seizes the ankle of the dislocated limb, while the surgeon stands upon the dislocated side, with a strong band passed beneath the upper part of the thigh and over his shoulders. The first assistants now make steady the pelvis, the second draws the dislocated limb under and across the sound limb, while the surgeon, by erecting his body, lifts forwards, outwards, and a little upwards, that is, towards the head of the patient.

The following is Dr. Bigelow's method of reducing this dislocation by "rotation:" "Flex the limb towards a perpendicular, and abduct a little to disengage the head of the bone; then rotate the thigh strongly inward, adducting it, and carrying the knee to the floor. The trochanter is then fixed by the **Y** (ileo-femoral) ligament and the obturator muscle, which serve as a fulcrum. While these are wound up and shortened by rotation, the descending knee pries the head upward and outward to the socket." The reduction may be facilitated sometimes. Dr. Bigelow adds, by drawing the head of the femur outwards and upwards, and in other cases by outward rotation. Prof. Gunn declares that in this dislocation it is the posterior and superior portion of the capsule which remains untorn.

Fig. 145.



Reduction of a Thyroid Dislocation—Bigelow.

Dislocations of the Patella.

The patella may be dislocated outwards, inwards, upwards, or it may be dislocated upon its own axis.

Dislocation Outwards is the most frequent. Reduction is effected by laying the patient upon the floor, while the surgeon, lifting the leg and thigh, places the heel upon his own shoulder, so as to relax completely the quadriceps femoris, and then pushes the patella with his hand toward its natural position.

Inward Dislocation is reduced by the same manœuvre.

Dislocation Upwards can only occur as a consequence of a *rupture of the ligamentum patellæ.* The treatment of this accident is the same as for a transverse fracture of the patella. (See Fractures of the

Patella.) Union generally takes place after six or eight weeks, with a somewhat elongated ligament, but without sensible impairment of the functions of the limb.

A rupture of the quadriceps has occasionally been alluded to by surgical writers as a **Dislocation of the Patella Downwards.** I have seen several of these accidents, but in no case has the patella become displaced downwards, in any other sense than that it remained stationary when the knee was flexed. In some cases the rupture is partial, and the maiming which results is very slight; while in others, where the rupture has been more complete, the power of extending the limb is greatly impaired, if it is not wholly lost.

The treatment consists in rest in the recumbent position, while the limb is elevated upon an inclined plane, the action of the muscles being restrained at the same time by properly adjusted bandages.

Dislocation of the Patella upon its Own Axis.—In which case one margin of the patella rests upon the centre of the articulating surface of the femur, while the other margin presents directly forwards. This dislocation, fortunately very rare, has sometimes been found difficult to reduce. In some few cases reported, the rotation of the patella on its axis is said to have been nearly or quite complete, and the difficulty of reduction has been thereby greatly increased.

The limb must be first placed in the position recommended for the reduction of a lateral luxation of the patella, and an attempt made to turn the patella over, by pressing against its upper margin, in case it projects, while counter-pressure is made by the handle of a large key against its lower margin. If this fails, the leg must be flexed upon the thigh and then again made straight, while pressure is continued.

Dr. Gazzam, of Pa., cut the ligamentum patellæ in a case of this kind, without any benefit, although he reduced the dislocation finally by flexion combined with pressure; and Samuel Cooper relates a case in which the surgeon cut both the ligamentum patellæ and the tendon of the quadriceps, the patient having finally succumbed to the articular inflammation which ensued, with the dislocation unreduced.

Dislocations of the Tibia and Fibula.

Dislocation of the Tibia at the Knee-joint.—The tibia may be dislocated upon the femur in all directions. In a majority of cases the dislocation is, however, incomplete. Complete dislocations at this articulation are in most cases compound and complicated, and often demand immediate amputation.

The reduction of all forms of knee-joint dislocations is generally easily accomplished. In either of the lateral displacements, simple extension will in most cases succeed. If the dislocation is backwards, forced and extreme flexion has seldom or never failed. If the dislocation is forwards, the manipulation must be reversed.

Dislocation of the Upper End of the Fibula from the Tibia has occurred in a few instances; and generally as a consequence of the violent action of the muscles inserted near the head of the fibula. Whether dislocated forwards or backwards, it has in nearly all the reported cases been most easily reduced by pressure made upon the fibula, while the leg was flexed upon the thigh.

Dislocations at the Ankle-joint.

Correctly speaking, this joint is liable to dislocation in only two directions, namely, **Forwards** or **Backwards**; and all of the examples of these dislocations seen by myself have been incomplete.

The reduction is in most cases easily effected by extension and suitable pressure.

What is termed a dislocation **Outwards** or **Inwards**, is in fact a rotation of the astragalus upon the lower end of the tibia, and is usually accompanied with a fracture of the fibula, and a rupture of the internal lateral ligament of the ankle-joint. Sometimes the ligament is not torn, but the internal malleolus is broken off.

Unless there is some extraordinary complication with this accident, the foot is easily restored to position and the bones to place. For the subsequent treatment the reader is referred to fractures of the fibula.

Nélaton has related the only example of **Dislocation of the Lower End of the Fibula from the Tibia**, which I have found upon record. The malleolus externus was forced directly backwards. The dislocation had existed thirty-nine days, and no attempt was made to reduce it.

Dislocations of the Bones of the Foot.

Dislocations of the Tarsal Bones.—All the bones of the tarsus are liable to dislocation singly or in groups. These must always be considered very serious accidents, since they are the results only of great violence; they are difficult to reduce, and, whether reduced or not, serious and destructive inflammation is apt to ensue.

The young surgeon must take care not to mistake congenital malformation, or malformation the result of a relaxation of the ligaments, or hypertrophy consequent upon ostitis or periostitis, for dislocation.

When the bones can be reduced by moderate pressure, aided by extension, the reduction is sometimes followed by a favorable termination: but in case great force is required to accomplish the reduction, or if the dislocation is complete, or nearly complete, and compound, resection is the proper alternative.

Dislocations of the Metatarsal Bones, and of the Phalanges of

the Feet are exceedingly rare. Their treatment is subject to the same rules as govern the treatment of the corresponding bones of the hand.

Congenital Dislocations.

Nearly all the joints of the body are subject to congenital displacement. The causes of these displacements may be arranged as follows:

First, mechanical, or traumatic; being occasioned, it is supposed, by some peculiar and constrained position of the fœtus in utero; by violent contractions, or constant pressure of the uterine walls; by falls, or by blows received upon the abdomen of the mother; by the contraction of the neck of the uterus; or by the hands of the accoucheur, in the act of delivery.

Second, pathological causes; such as lesion or disorders of the nervous centres; contraction or paralysis of muscles; preternatural laxity of articular ligaments; hydrarthrosis; or some other disease of the articular apparatus.

Third, physiological causes; consisting in an original defect of the germ, and resulting in imperfect development of the articular apparatus.

It is apparent that for treatment to be successful, the nature of the cause must, in some degree, be recognized. Those few examples which are due solely to mechanical causes are subject to the same laws which govern the treatment of post-natum traumatic luxations. Physiological and pathological displacements, of whatever nature they may be, imply always a failure or imperfection of the joint apparatus, and the treatment of these cases can only be regarded as palliative.

The means which have been found most successful are, adjustment, so far as this may be practicable by extension and pressure; and its maintenance by appropriate apparatus.

For a more complete consideration of this subject the reader is referred to the chapter on congenital dislocation in my treatise on Fractures and Dislocations, and to the numerous special treatises to which reference is there made.

CHAPTER XVIII.

AMPUTATIONS.

SECTION 1.—GENERAL CONSIDERATIONS.

Conditions demanding Amputation.

It is impossible to indicate, except in the most general manner, what conditions of the limbs demand, or what conditions of the general system warrant, amputations.

Amputation is practised for the removal of members which are suffering under incurable diseases, or irreparable injuries or deformities. It is therefore always an acknowledgment that all other surgical as well as therapeutic expedients have failed, and it is accepted only as the last resort.

Period of Time at which Amputation ought to be made.

In general it may be said that, if amputation is decided to be inevitable, unless there is some condition of the general system to forbid, the sooner it is made the better. The fact, however, that such conditions often exist, and that, especially after the occurrence of severe accidents, they are apt to assume greater or less prominence at different periods of the progress of the case, has led to a division of the time which elapses subsequent to the receipt of the injury into immediate, primary, intermediate, and secondary periods. Surgical writers are not exactly agreed upon the limitations which they assign to those periods, nor indeed upon the nomenclature; but the differences are not very important.

The **Immediate** period is the space of time comprised within the first few hours; and it will be convenient to establish its limit at the expiration of six or twelve hours. It refers to that condition of the general system, and more especially of the nervous system, which has been termed "shock."

The **Primary** period, or the period intervening between the occurrence of reaction on the one hand, and the accession of inflammation on the other, may be said to commence at the end of six or twelve and terminate at forty-eight hours. It has been called also the period of "reaction."

The **Intermediate** period ("mediate," "consecutive," or "secondary" of some writers), so called because it is intermediate between the primary and secondary, is limited on the one hand by the accession of inflammation—usually about forty-eight hours after the receipt of the injury—and on the other by the occurrence of healthy suppuration, which latter limitation is exceedingly variable, and may be sought for anywhere between seven and twenty-one days. It is the period of inflammation; sometimes of congestion.

The **Secondary** ("ulterior" or "consecutive" of some writers) is the period of complete suppuration, and its limits are indefinite.

Shock is that condition of the nervous system which immediately ensues upon severe injuries in certain persons, characterized by coldness of the surface, pallor, and a feeble pulse; to these conditions are sometimes added tremors, a wild, anxious expression of the face, partial or complete paralysis of the bladder and sometimes of other organs, mental disquiet or apprehension, incoherent speech, etc.; which phenomena may continue a longer or shorter period, but usually, unless the shock is severe, they disappear in a few hours. When the accident is of a more grave character, no reaction occurs, and the patient dies immediately, or within a short time. In general it may be said, that if reaction does not occur within twenty-four, or at most forty-eight hours, the patient will die.

In some cases the occurrence of the shock seems to be delayed, the depressing influence of the injury not being felt until some little time after. Such, at least, is the opinion of Mr. Macleod, who affirms that he knows of several well-authenticated cases which prove the correctness of the position. Lidell also believes that the shock is generally delayed. For ourselves, we confess that we have never met with these examples, except when some visceral lesion, or the rupture of a large blood-vessel, has accompanied the accident. It is true that men often faint after a few minutes, or after removal, and when they have had time to contemplate their situation, who seemed undisturbed at first; and in other cases, a severe and prolonged irritation from a point of bone has steadily aggravated the signs of depression and of shock; but we think these cannot with propriety be termed examples of delayed shock. We do not, however, intend to deny absolutely that the nervous agitation may be delayed in some cases; but only to express a conviction, founded upon our own experience, that if the condition to which these gentlemen have called our attention does ever occur, it is, to say the least, a rare phenomenon.

Surgeons who hold to the frequent occurrence of delayed shock, recognize in this an argument in favor of "immediate" amputation in a great majority of cases; and certainly, assuming the premises to be correct, the argument seems not unsound. Says Macleod, "If this precious moment could be seized at all times, and that operation performed under chloroform, which assists so much in warding off the 'ébranlement' we fear, how much more successful would our results prove than under other circumstances they can ever be."

The idea of immediate amputation did not, however, originate with those who maintain that the shock may be, and is in fact, often delayed. Ambrose Paré urged that amputation should be made while the wounded were in sight of the battle-field; and Richard Wiseman, sergeant surgeon to Charles the Second, said, "If you decide to operate, do so at once, while the soldier is in heat and mettle."

Larrey, indeed, seemed to regard amputation as the proper remedy for this peculiar condition of the nervous system. "I have lost," said he, "a great number of soldiers, because, although operated upon within the first twenty-four hours, yet the operations had been made too late." . . . . . "It is then demonstrated that the commotion, far from being a contra-indication to primitive amputation, ought to decide the surgeon in its favor." . . . . "The effects of the commotion, far from being aggravated, diminish and disappear insensibly after the operation."

Dr. Stephen Smith, in his analysis of certain determined cases of amputations,[1] has observed that in a total of four hundred and thirty recovered amputations, thirty-six per cent. were made within six hours; and he has estimated that the rate of recovery was six per cent. better in these cases than in those in which the amputation was made in the period of reaction, or what I have termed the primary period. Without calling in question the accuracy of these statistics, which seem to have been prepared with great fidelity and labor, I feel obliged to say that until the precise condition of those patients operated upon during these first six hours is determined, as well as the condition of those operated upon during the twenty-four subsequent hours, the testimony furnished by the tables must be very inconclusive; and that they in no way invalidate my opinion, that operations made while the patients are laboring under shock are especially hazardous. Moreover, when it is seen that in Dr. Smith's calculations the proportion of deaths to recoveries is only inferred, not absolutely known, it must be apparent that his conclusions and inferences ought not to be accepted as the basis of future practice.

My attention has just been called to an observation made by M. Sédillot, of Lyons, who, in the course of the late Franco-Prussian war, has had a very large experience in amputation, according to whom "the best rule is to amputate on the second or third day." I must differ from him so far as to say that in general the first or second days are to be preferred, that is, the period after the shock, but within the first forty-eight hours.

My own opinion upon this subject is, that amputations ought to be made in some cases immediately, or as soon as possible after the receipt of the injury; as, for example, when a limb is nearly torn off and a dangerous hæmorrhage, which cannot be arrested, is occurring; or when spicula of bone, such as neither the forceps nor fingers can extricate, are causing intense suffering. In all cases of injuries to small limbs, such as the fingers and toes, immediate amputation is proper; and in a considerable number of cases of injuries to larger limbs, when it is clearly seen that the patient is not faint, or depressed, or suffering under great nervous commotion. But I cannot accept of the doctrines of Paré, Wiseman, Larrey, Macleod, and others, without liberal qualifications, and a careful specification of the cases to which their rules are to be made applicable.

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[1] *Analysis of* 439 *Recovered Amputations in the Contiguity of the Lower Extremity,* by Stephen Smith, M.D. Second vol. *Surgical Memoirs U. S. Sanitary Commission.*

It may be that, as Hutcheson declares, the condition which we term shock is not so frequently present as has been generally supposed, even after severe injuries; or that, as Macleod maintains, there is generally an interval, longer or shorter, between the receipt of the injury and the accession of the nervous commotion. These points may be safely left open for future inquiry; but upon one thing I must insist, namely, that when the nervous agitation or depression is actually present in any considerable degree, amputation of a large limb is generally a most dangerous resource. Amputation may then be necessary for the reasons stated, and possibly for other reasons, but the necessity is greatly to be deprecated. My own experience has been that amputations of large limbs, made after severe injuries, and before complete reaction from shock has taken place, have generally resulted speedily in the death of the patients; and this, I believe, has been the experience and testimony of most practical surgeons.

Our first duty, then, to many who have fallen upon the field of battle, or who have suffered severe injuries in civil life, is to comfort and sustain them by words of encouragement, by the administration of water, wine, brandy, with perhaps a few drops of chloroform, or by a cup of warm tea or coffee; and, having dressed the wounds temporarily, and covered the body and limbs with warm blankets, to wait patiently the establishment of reaction before proceeding to the operation.

The danger of amputating in what is termed the intermediate period can scarcely be over-estimated. This period is marked by two conditions.

The first, and that which is most generally understood by surgeons, is a well-defined condition of inflammation, with the consequent swelling of the limb; commencing at variable points of time after the receipt of the injury, and progressing with unequal rapidity in different cases; but it is seldom well declared within the first twenty-four hours, and it is rarely delayed much beyond forty-eight hours.

The second condition has not been so often noticed by surgical writers. It consists in a serous, with perhaps more or less bloody infiltration of the tissues, unaccompanied with marked signs of inflammation, and is not attended with much general reaction in the system. I have found this condition present on the second and third day in a pretty large proportion of cases; and I have constantly observed that death results even more certainly after amputation under these circumstances than when the limb is actually inflamed.

The period, therefore, for primary amputations is restrained within narrow limits; and I deem it my duty to say that immediate amputations are greatly to be preferred to intermediate; and if for any reason the omission to amputate at once is likely to carry the case into the intermediate period, the sooner it is done the better; and I am sufficiently acquainted with field practice to know that this alternative is often presented to the military surgeon. I will say further, that if surgeons cannot be made to comprehend the danger of delay until congestion and inflammation have ensued, they had better receive peremptory instructions to make all their amputations at the earliest possible moment; and if we speak of military surgery alone, in every case of doubt the surgeon should be advised to lean toward amputation as to the side of hope. More lives have been lost from attempts to save limbs, especially in the case of the lower extremities, than from amputations unnecessarily made, or made too early.

The next question to be determined is as to the relative safety of primary amputations and secondary. In civil practice secondary amputations have been claimed to be more successful than primary; but the observations of Lidell have rendered this doubtful. It is probable that if attention was directed only to those amputations made in civil practice for traumatic injuries, the results would be found to be favorable to primary operations. In regard to the upper extremities, the statistics gathered with much care by Dr. Stone of this city confirm these opinions.[1]

If we would look for advocates for secondary amputations in military practice, we must seek for them mainly among army surgeons of the last, or of the early part of the present century. Faure, who was in the battle of Fontenoy, says, "Amputate after the subsidence of the first symptoms, and suppuration is produced." John Hunter held the same views. Baron Percy, in 1792, taught a similar doctrine; and in the present century Blandin and Manse arrayed themselves upon the same side; while Petit, Le Drau, Bromfield, Boucher, Guthrie, Hennen, Roux, Rush, Armand, Macleod, Guthrie, and a host of others, have decided in favor of primary amputations.

Age exerts an important influence in the mortality of amputations. In general it may be stated that the older the patient, the greater is the liability to death.

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[1] John L. Stone, Surgeon to Bellevue Hospital, *New York Journal of Medicine*, November, 1849.

Amputations of the lower extremities present a much higher rate of mortality than amputations of the upper.

Point at which Amputation is to be made.

This will depend very much upon the part of the limb which has suffered injury; but in general we may say, amputation should be made as far from the body as a thorough removal of the injured or diseased structures will permit. In other words we may state the rule to be, that we must save as much of the limb as possible. Yet in no case should the life of the patient be put at hazard for the sake of a limb, and much less for a small portion of a limb.

There are two reasons why we adopt the rule above stated: first, because the longer the stump, other things being equal, the more useful it will be to the possessor: second, because experience has shown that the nearer an amputation is made to the body, and the larger the diameter of the limb, the greater is the danger to life. Thus, according to Malgaigne, only 1 death occurred from 26 amputations of the smaller toes; 7 from 46 amputations of the great toe; 9 from 38 partial amputations of the foot; 106 from 192 amputations of the leg; 126 from 201 amputations of the thigh. Again, in the Crimea, the mortality after amputations of the thigh, in a certain number of cases, was as follows: lower third, 56 per cent.; middle third, 60 per cent.; upper third, 86 per cent.; hip-joint (23 cases), 100 per cent. Analysis of 9,705 amputations recorded in the Surgeon-General's office at Washington, shows a percentage of mortality as follows: in the fingers and parts of the hand, 1.60; wrist, 5.55; elbow, 00; forearm, 16.52; arm, 21.24; shoulder, 39.24; toes, .75; partial amputations of the foot, 9.24; ankle-joint, 13.43; leg, 26.02; knee-joint, 55.17; thigh, 64.43; hip, 85.71.[1]

In a few exceptional cases we may find it convenient or necessary to deviate from the rule given above, but the circumstances under which these exceptions are permitted will be more appropriately mentioned in connection with special amputations.

Amputations made through articulations are termed "disarticulations," or amputations "in contiguity;" when made through the shafts of bones they are termed amputations "in continuity;" a limb amputated a second time is said to be "reamputated;" when two corresponding members have been amputated at the same time, it is called a "double amputation."

Method of Amputation.

There are two principal modes in which amputations are performed, namely, the circular and the flap: as to which of these methods ought generally to be preferred, surgeons have held different opinions. In this country the flap method has generally been adopted, especially by the younger surgeons. Without entering into a discussion of the relative merits of the two operations, I will simply state my belief that both have special and appropriate applications, depending upon the point at which the amputation is to be made, the character of the injury, the general condition of the patient, and the circumstances which are to attend the subsequent treatment.

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[1] *Circular No.* 6, Washington, 1865.

The regions in which one or the other method may properly claim, or imperatively demand a preference, will be indicated in connection with the special amputations. When the character of the injury is to decide the preference, the surgeon alone can determine the choice after he has examined the limb, and ascertained what resources the lacerated tissues offer for a proper covering to the stump. In relation to the condition of the patient, it is my opinion that when, in consequence of long-continued suppuration, exhausting hæmorrhages, or any other cause, the system is greatly enfeebled, the circular method ought generally to be chosen; and for the reason that the tegumentary coverings of a circular amputation are less liable to gangrene and suppuration, and to become depots of foul secretions by which the system may be contaminated, than are the large fleshy masses formed in the flap operations.

There is one other point in this connection, relating chiefly to military surgery, to which it seems necessary to call attention. Whenever a patient is to be transported, immediately or soon after the operation, a long distance, preference ought always to be given to the circular amputation, at least in the case of all large limbs, and especially in the case of the lower extremities. The heavy flaps attached to the end of the limb, disturbed by incessant motion, are exceedingly apt to loosen and become gangrenous. This was the experience of the Crimean surgeons, where soldiers were transported long distances by land after amputation; and even when carried upon transports to Scutari the same fact was observed. Under my own observation in the late war the same experience has been repeated hundreds, nay thousands of times. Even where soldiers have been removed only short distances upon the field, or have received inadequate attention while lying in their tents or upon the ground, I have had occasion to notice the greater frequency of sloughing and of secondary hæmorrhage in limbs amputated by the flap method. In short, it may be safely affirmed that flap amputations exact greater care in the dressings and more quietude than circular, and whenever these cannot be insured the latter method is to be preferred.

A consideration of the various modifications of the circular and flap operations—such, for example, as the oval, the rectangular, etc.—will be reserved for the occasions in which they have been claimed to be especially applicable.

SECTION 2.—SPECIAL AMPUTATIONS.

A careful study of the superficial or exterior anatomy of the joints, and repeated dissections, with amputations made upon the cadaver, have furnished me with more reliable guides to some of the articulations than have hitherto been described, and with more simple methods of effecting disarticulation. The "guides" will generally be found in certain bony projections; but the "keys" to the joints are in most cases some one or more of the ligaments which hold the joint-surfaces in close apposition, and which effectually prevent the joints from being opened while they remain uncut. In a few examples certain muscles take the place of ligaments, and must therefore be divided before the knife will be permitted to enter the articulation. The value of most of these observations I have also been permitted to verify upon the living subject.

I shall deem it proper, therefore, when speaking of amputations in contiguity, to describe with some detail the peculiar anatomical arrangement of each joint, and to indicate in what manner the operator may avoid those delays and embarrassments which so often attend disarticulations.[1]

Amputations of the Hand.

Amputation of the Fingers and Thumb at the Second and Third Phalangeal Articulations.—The second and third phalangeal articulations are ginglymoid. When these phalanges are flexed to a right angle, the articular surface at the distal end of the proximal phalanx is exposed by the displacement of the proximal end of the distal phalanx; and in order to open the joint, the edge of the knife must be laid upon the dorsal surface at a point one-quarter or three-eighths of an inch beyond the most salient point of the convexity formed by the articulation, more or less, according to the thickness of the phalanx. Each joint is embraced by its capsule, one palmar and two lateral ligaments, and either one of the lateral ligaments may be considered as the key to the joint.

Disarticulation is effected as follows. The distal, being flexed upon the proximal phalanx, a transverse incision is made upon the dorsal aspect at the point already indicated, by which, at the same moment, the integument, extensor tendon, and capsule are divided; but although the joint is then freely exposed, the joint-surfaces cannot yet be separated. Dividing now with the point of the knife either one or both of the lateral ligaments, the joint falls open, and the knife may pass through the articulation and complete the operation by forming an oval flap as it emerges upon the palmar surface. In general, however, it is better to form the palmar flap by cutting from the surface toward the joint, as by the opposite method the flap is apt to be too narrow.

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[1] "Guides and Keys to the Joints," by the Author. *Richmond and Louisville Med. Jour.*, Dec., 1868.

The digital arteries seldom or never require a ligature; and the method of dressing which I usually adopt is to bring the palmar flap into position, and secure it in place by a narrow bandage laid over the stump in the direction of the long axis of the finger, which strip of cloth is then made fast by a few circular turns of the roller.

Lassus was, I think, the first to suggest that amputation at the distal extremity of the first phalanx should never be practised, since neither of the flexors had any attachment to this bone, and it must remain ever after an immovable, projecting stump. The same opinion has been reiterated by most surgical writers since his day. But I have many times demonstrated, in the case of patients upon whom this operation has been made, that the statement of Lassus is incorrect, and that, in a large majority of cases, the power of flexion is retained in a sufficient degree to render the phalanx very useful; indeed, in most cases the power of flexion has, after a time, been found to be but little less than that of the other fingers. The explanation is found chiefly in the fact that the flexor tendons are connected with the distal extremities of the first phalanges by tendinous processes, called vincula accessoria tendinum. I have observed, also, that considerable power of flexion is retained when the amputation is made at or near the middle of the phalanx; in which case the explanation must be sought in the actions of the palmar interossei and the lumbricales. There is no sufficient reason, therefore, why the amputation should not always be made, whenever it is found practicable to do so, at the extremity of the first phalanx, or indeed through any portion of its shaft, unless it be very near the hand.

Metacarpo-phalangeal Articulations.—The metacarpo-phalangeal articulations are enarthrodial; but, when the first phalanx is flexed, the distal extremity of the metacarpal bone is uncovered in the same manner as has already been described in the case of the phalanges, so that the articulation which, when the finger was straight, was situated near the summit of the convexity called the knuckle, is now removed three-eighths or one-quarter of an inch farther forwards.

Amputation of the Second or Third Finger at the Metacarpo-phalangeal Articulation.—This amputation is made with double, lateral flaps. The finger being held in a straight position, with the adjoining finger drawn aside, the knife is introduced upon the free margin of the interdigital commissure and carried obliquely to the bone, the incision being extended on the dorsal aspect as far as the centre of the prominence of the knuckle, and upon the palmar aspect to the under surface of the articulation, which is usually about three-quarters of an inch from the extremity of the commissure; a similar incision is then made upon the opposite side of the finger, commencing and terminating with the first incision; the flaps are dissected from the bone, taking care to carry the edge of the knife out over the expanded end; the lateral ligaments are cut, and the disarticulation is completed by dividing the flexors and extensors, with the capsule. Usually no arteries require the ligature. The flaps are brought in apposition with two or three fine sutures, and maintained in place by rollers.

The practice of making the amputation through the distal end of the metacarpal bone as a substitute for the disarticulation now described, for the purpose of narrowing the chasm between the adjacent fingers, does not much diminish the deformity, while it increases the difficulties and dangers of the operation, and weakens the grasp of the hand.

Amputation of the First and Fourth Fingers at the Metacarpo-phalangeal Articulation.—It is most convenient to employ here, also, two lateral flaps. The deformity resulting from the disarticulation is greater than in the case of the second and third fingers, and the objections to the substitution of amputation at the distal extremity of the metacarpal bone have less force. In case the substitution is made, the metacarpal bone should be sawn or cut obliquely.

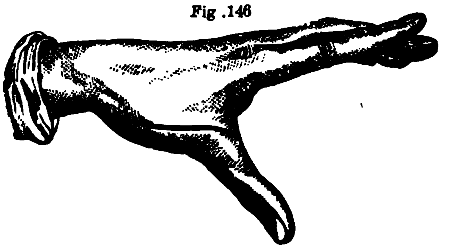
Amputation of all the Fingers at the Metacarpo-phalangeal Articulations.—Amputation of all the fingers, or of two or more adjacent fingers at this articulation, should be made with a single palmar flap, as follows; the fingers being grasped by the left hand of the surgeon and slightly flexed, while an assistant retracts the integument on the back of the hand, the knife is carried across the dorsal aspect of the fingers in the line of the articulations, dividing the skin, extensor tendons and capsule, and also the lateral ligaments: turning the palm of the hand upwards, the palmar flap is constructed by making an incision to the bones, from the radial to the ulnar sides, or *vice versa*, near the free margins of the interdigital commissures, and dissecting up the integument with other soft parts to the line of the articulations. The remaining articular attachments being divided, the flap, which will be found to be ample, is brought into place and secured by sutures and adhesive strips. It is seldom that the arteries require the ligature, their bleeding ceasing promptly when the roller is applied.

Amputation of the Phalanges in Continuity.—In the case of amputations made through the shafts of these bones, it is still preferable to employ always the single palmar flap when the condition of the parts will permit, for the reason, chiefly, that the cicatrix is by this method removed to the dorsal surface, and the tactile sensation of the extremity of the stump is consequently less impaired.

In dividing the bones we may use either a fine spring-back and well-set saw, or the bone-cutters. A coarse saw is a very rude instrument for the division of these small bones, and the bone-cutter is not without its inconveniences; but if the latter instrument is sharp, and is made to grasp the phalanx by its longest or transverse diameter, the incision will generally be sufficiently clean and smooth, and especially if the patient be a child; but unless these conditions obtain, the phalanx is apt to be crushed and splintered, which accidents usually result in tardy union or necrosis of the bone. Where the separation has been made just below the articulation, in adults, I have seen exfoliation of the fragments occur pretty often. In the case of young children the separation of the bone is most easily and safely effected with a knife.

Amputation at the Carpo-metacarpal Articulation of the Thumb.—Amputation at this joint may be made by double flaps with great expedition and facility; but it is desirable always to maim as little as possible the muscular eminence constituting the ball of the thumb, and for this reason the oval flap incision ought to be preferred.

Fig. 146



Amputation at the Carpo-metacarpal Articulation of the Thumb.

The incision is commenced on the dorsal aspect of the thumb, opposite the articulation of the trapezium with the metacarpal bone, and carried obliquely to the inter-digital commissure, across the palmar aspect of the thumb and again obliquely across the dorsal surface to the point of beginning. By a somewhat tedious process the soft structures are now separated from the bone until the internal lateral ligament is exposed, avoiding carefully the radial artery where it dips between the first and second metacarpal bone to form the deep palmar arch. Cutting the internal lateral ligament, which is the key to the joint, the thumb is thrown forcibly outwards, and the disarticulation is at once easily effected. Attempts to enter the joint from the outer side expose to the danger of including the trapezium; and the joint cannot be so completely opened when the external lateral ligament is first divided, on account of the forced adduction being arrested by the adjacent metacarpal bone.

Amputation at the Carpo-metacarpal Articulation of the Little Finger.—The same rules of procedure are applicable here as in the case of the thumb, except that the key to the articulation will be found to be the external lateral ligament, or the ligament lying in juxtaposition to the ring-finger. The oval incision ought always to be preferred, although the double flap is the most easy of execution. It is seldom, either in the case of the thumb or little finger, when the oval incision is made, that any vessels require the ligature.

Amputation at the Carpo-metacarpal Articulations of all the Fingers; and Amputation between the two Rows of Carpal Bones, or Medio-carpal.—These amputations have occasionally been described in systematic treatises, but I have never seen them practised; nor do I think they are entitled to a place among established operations. It is probable that the carpal bones thus left would be soon loosened and thrown off by suppuration; and it can scarcely be considered worth while to incur these risks for the sake of the trifling gain of an inch or two in the length of the limb. This constitutes, therefore, a proper exception to the general rule that we should save as much of the limb as possible.

Amputation at the Radio-carpal Articulations—Wrist-joint.—The guides to this articulation are the styloid processes; and especially the internal, which is shorter than the external, and therefore leaves the joint more uncovered and accessible. Approaching the articulation from the outer side, I have observed that there is always some danger of entering between the two rows of carpal bones. For the same reason, also, the internal lateral ligament constitutes the most appropriate key to the articulation.

Those who have preferred for this amputation the flap, or oval incisions, made from either the palmar or dorsal aspects of the hand, have not sufficiently considered the risks of leaving the styloid processes exposed. If one were only to study effect in class-room demonstrations, we might even adopt the practice recommended in some treatises, of making the anterior flap by transfixion; but I must regard all these methods, when applied to amputations at the wrist-joint upon the living subject, as inappropriate; and the same may be said of a multitude of incisions suggested from time to time for amputations of other portions of the body. The circular incision alone furnishes an adequate covering for the processes.

The circular amputation is made as follows: the operator makes, with a large bistoury, a circular incision about one inch and a half below the styloid processes, and while an assistant retracts forcibly the integuments, they are dissected from the subjacent structures. On the dorsal surface this dissection is accomplished with great ease; but on the palmar surface the separation of the integument from the fascia is more difficult, and the surgeon will find it convenient, generally, to include everything in the flap except the tendons. Having reversed the integument, search must be made for the point of the internal styloid process, and the internal lateral ligament must then be divided by entering the edge of the knife below the process, and carrying it a little upwards and outwards. When this is accomplished the radius separates freely from the lunare, and the disarticulation is easily and quickly effected.

Reference has been made to the danger of entering between the two rows of carpal bones by approaching this articulation from the radial side. It ought also to be mentioned that in the attempt to enter the joint from the palmar surface the operator is very prone to fall above the expanded end of the radius, in consequence of mistaking the latter for the carpal bones.

The amputation being completed, the radial, ulnar, and interosseous arteries may require to be tied. The tendons should be cut off by a clean incision, where they hang out from their sheaths; but they must not be drawn out forcibly and then divided. In closing the wound the flaps are to be approximated from the palmar to the dorsal surfaces;

and now the peculiar excellence of the circular incision wil. become apparent, as the excess of integument will form pouches on each side, over the styloid processes, which will effectually prevent any protrusion of the bones.

The wound being closed by sutures, adhesive strips, lint covered with simple cerate, and a roller, the arm should be laid upon a pillow, with the stump slightly elevated.

Amputations of the Forearm.

Amputation of the Forearm in Continuity, below its Middle.—On account of the small amount of muscular tissue usually found in this portion of the arm, the circular incisions are generally preferred. The same objection holds to the flap operations here, also, as at the wrist: they do not sufficiently cover in the bones at the angles of the incisions. Usually, after having divided the soft parts, including the interosseous ligament, the muscles and integuments are held away from the saw by a retractor, made of a piece of cotton cloth, one end of which is torn into three strips, and the central strip being pushed between the bones, an assistant draws the tissues upwards, while the operator with a knife exposes the bones more completely and then applies the saw.

Three or four arteries usually require the ligature. The dressing is the same as after a wrist-joint amputation.

Amputation of the Forearm in Continuity, above its Middle.—We may adopt here either the single or double-flap amputation. I have generally preferred the single anterior flap.

In this, as in all other amputations of the forearm, the arteries may be controlled by an assistant pressing firmly upon the brachial artery; or a tourniquet may be applied.

In the case of the left arm, while one assistant retracts the integument, and a second holds the forearm in a position of supination and extension, the surgeon, standing on the ulnar side of the forearm, makes, with an amputating knife, an incision across the dorsal aspect of the limb, by drawing the knife from its heel toward its point, cutting clean to the bone, and embracing in the incision the semi-circumference of the limb. Grasping and lifting with his left hand the mass of muscles, etc., which is to constitute the anterior flap, the operator enters the point of his knife at the ulnar extremity of the incision already made, and, bringing it out upon the opposite side, cuts downwards and obliquely toward the surface, making a flap of about three inches in length. The retractor being drawn well up, the bones are divided by the saw applied at the same time both to the radius and ulna. If the amputation is made at a higher point and near the elbow-joint, the radius should be severed first.

The subsequent dressing will be sufficiently understood by a reference to amputations at the wrist-joint already described.

Amputation at the Humero-ulnar Articulation—Elbow-joint. —The elbow-joint is a complex, but purely ginglymoid articulation, admitting of no lateral motion. The joint is supported by its capsule, by its anterior and posterior ligaments, all of which are thin and loose, only limiting the joint in its extreme conditions of extension and flexion; and by strong lateral ligaments, which hold the joint-surfaces compactly together. The division of either one of these latter ligaments would unlock the articulation, but when the joint is still covered with integument and muscle, the exact position of the internal lateral ligament is with difficulty defined; there is usually, however, no difficulty in finding the external lateral, which passes from the external condyle of the humerus to the orbicular ligament, enclosing the head of the radius. The following rule is to be observed in searching for this ligament:—

The forearm of the patient is flexed to a right angle with the humerus, so as to displace the mass of muscle which partly conceals the head of the radius when the forearm is extended. The right hand of the surgeon grasps the right hand or wrist of the patient, while the left seizes the elbow in such a manner as to place the thumb upon the external condyle of the humerus. The thumb is then allowed to slide off from the condyle toward the hand, until only the upper margin of the thumb touches the condyle, when its lower margin will be felt resting upon a slight elevation, which is the head of the radius. The space between these two points is, in adults, about half an inch. Pressing down with some firmness upon the head of the radius, while with the right hand the radius is pronated and supinated, its head will be felt rotating under the thumb. The head of the radius rotates upon its own axis, and, to recognize its motion, it is generally necessary to move it slowly and observe it attentively. The patient must also be instructed not to aid in the motion of rotation, otherwise the contraction of the muscles will obscure the sensation. With these precautions, the surgeon will seldom fail to recognize the head of the radius; he will even be able to define accurately the situation of its upper margin, and to put a pin into the joint, if he chose to do so, with almost unerring certainty; and this is the precise point where, by a transverse incision, he will cut the external lateral ligament and freely expose the joint.

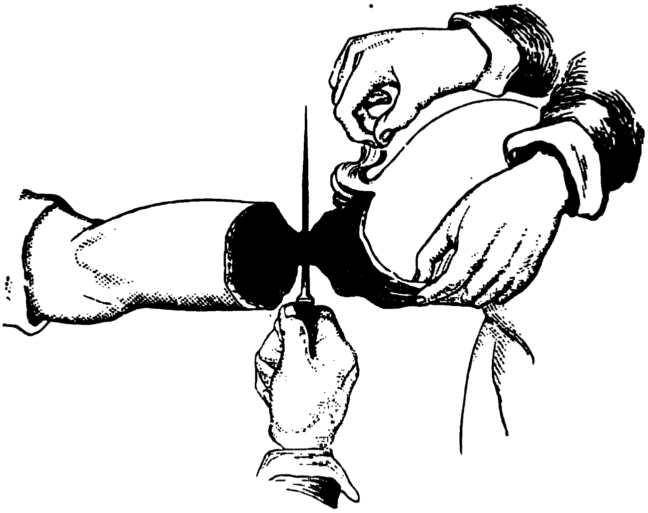
In case the operator were intending to make an amputation with a single anterior flap, he may now, having entered the articulation at the head of the radius, carry his amputating knife around across the posterior aspect of the arm, to the opposite or ulnar side, cutting through the integument down to the bone. Then, the assistant having completely and somewhat forcibly extended the forearm upon the arm, the surgeon may rapidly make the anterior flap, raising it up well to the articulation; and finally, placing the edge of the knife vertically upon the front of the joint, so that its extremity, near the point, rests in the open articulation between the radius and humerus, with one single sweep he will sever the remaining attachments of the biceps, the brachialis anticus, the anterior ligaments, the capsule, and the internal ligaments; leaving nothing to be divided but the olecranon process, the section of which will be completed by the saw. It is important in this procedure to extend the arm before the section of the brachialis anticus, etc., is made, otherwise the knife will strike against the coronoid process of the ulna. Nothing can exceed the facility and rapidity with which disarticulation at the elbow-joint can be made by this method.

Of 39 cases reported to the office of the Surgeon-General during the late war, only 3 terminated fatally, although 5 recovered only after submitting to re-amputation, three in the continuity of the upper arm, and two by disarticulation at the shoulder-joint. These favorable results accord with my own personal experience.

Amputations of the Arm.

Amputation of the Arm in Continuity may be made by either the circular or flap method. Most surgeons have preferred double lateral flaps. The operation by either method is so simple that no special description is required. It is important, however, to direct attention to the tendency in the muscles to retract and uncover the bone when the amputation is made above the middle; a circumstance which is due to the great length of certain muscles embracing the humerus, and to the fact that some of them have little or no attachments to the bone in

Fig. 147.



Amputation of the Arm in Continuity by the Double Flap Method.

this portion of the limb. In making a flap amputation this must especially be borne in mind, and the length of the flaps must have reference to their probable retraction after the operation is completed.

Amputation at the Scapula-humeral Articulation—Shoulder-joint.—In amputation at the shoulder-joint, the method which I have found to be the most easily executed and most economical in the expenditure of blood is as follows:—

First Step of the Process.—An assistant seizes the forearm at the elbow and wrist, and, in order that he may control its motion more perfectly, flexes it to a right angle with the humerus, and then raises the humerus to a right angle with the body. The surgeon, if it be the right arm, standing on the right side of the body and arm, with his face towards the patient's head, grasps with his left hand the muscular eminence formed by the deltoid muscle, and with his right hand, holding a large common bistoury, forms an oval, external flap, the apex of which reaches to within two or three inches of the insertion of the deltoid, and the base of which extends from near the coracoid process in front to a corresponding point below the acromion process behind. This flap is now rapidly dissected up until the outer extremity of the acromion process is fully exposed.

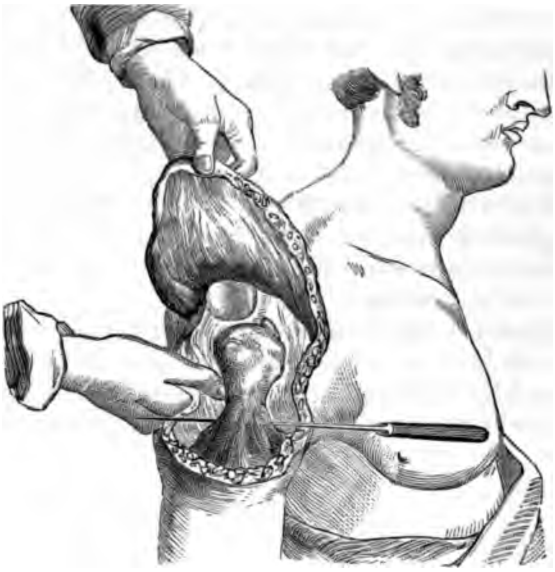
Second.—The assistant is directed to lower the arm nearly or quite parallel with the body, so as to expose more fully the head of the humerus, and especially its capsule and the coraco-humeral ligament. The knife, placed with its flat surface against the acromion process and its edge directed toward the head of the humerus, divides the coraco-humeral ligament, the upper portion of the capsule, and, perhaps, the long head of the biceps. These structures constitute the first key to the joint. This section does little more, however, than to open it fairly to view.

Third.—The assistant, still holding the forearm at a right angle with the arm, rotates the humerus forcibly inwards, while the surgeon, with one sweep of the knife, divides the supra-spinatus, the infra-spinatus, and the teres minor. These muscles constitute the second and most important key to the articulation, and it is quite possible now to open the joint sufficiently to pass a knife between the head of the humerus and the glenoid cavity. They are all inserted into the greater tuberosity, and inasmuch as they approach their points of insertion from above, from behind, and from below, the knife must be carried around the tuberosity with a firm hand, and in such a direction that the lower half of the incision shall pass down behind the tuberosity parallel to the axis of the humerus; indeed, the lower portion of the teres minor having a slight muscular insertion into the humerus below the tuberosity, it is well to extend this incision a little below the tuberosity and to incline it here slightly forwards.

Fourth.—The assistant rotates the humerus forcibly outwards, exposing the lesser tuberosity, and the surgeon, with a similar sweep around this tuberosity, divides the subscapularis. The subscapularis is the third and last key.

Fifth.—The joint now separates widely, and the surgeon, changing his bistoury for a seven or eight inch amputating knife, passes through the joint, dividing the remainder of the capsule and the long head of the triceps. Turning the edge of the knife toward the humerus, the incision is prolonged downwards, hugging closely the posterior surface of the bone to the extent of three or four inches

Fig. 148.



Amputation at Shoulder joint.

Sixth.—A second assistant, following the incision made beneath the head of the bone, passes his two thumbs from opposite sides into the wound and seizes the axillary artery between his thumbs and fingers, holding it firmly, while the surgeon completes the section of the axillary tissues. The amputating knife employed in this last step of the operation ought to have a straight, dull back. A double-edged knife endangers the hands of the assistant, and possesses no advantages.

It will be noticed that the second and third keys to this articulation are not, as is uniformly the case in other joints, ligaments, but muscles or tendons; the muscles, and not the ligaments, holding the joint-ends of the bones in contact; a fact which admits of easy explanation. The shoulder-joint has a greater latitude of motion than any other joint in the body. The capsule is, therefore, very loose, so that when all others of the soft parts are cut, it allows the bones to separate more than one inch. Only one ligament connects the scapula to the humerus, namely, the coraco-humeral, which, passing obliquely across the joint, from the coracoid process to the greater tuberosity, can only imperfectly limit its motions, and has no effect in holding the articular surfaces in contact. The muscles and tendons which embrace the joint, however, have such attachments and anatomical characters as to reinforce the capsule; and they do, in fact, take the place of ligaments. The long heads of the biceps and of the triceps, inserted respectively into the upper and lower margins of the glenoid cavity, have considerable effect in this regard; but the head of the humerus is held in place chiefly by the three short and strong muscles which I have named, coming from the back of the scapula, and which are inserted into the greater tuberosity. The power to accomplish this and to reinforce the capsule is greatly increased by their attachment to the capsule itself. The truth of this assertion is readily verified by a division of their tendons near the point of their attachment, when it will be plainly seen that they constitute the second and most important key to the articulation. The subscapularis, coming from the opposite side of the scapula and inserted into the lower tuberosity, is also short, strong, and is attached to the capsule itself, so that the joint cannot be completely opened until its tendon also is divided. This, therefore, constitutes the third, and, in point of importance, the second key to the joint.

I have elsewhere, and especially in my military surgery, expressed my preference for Larrey's amputation at the shoulder-joint; but later experience has taught me that the method I have now described is, in several respects, to be preferred.

Of 852 cases of amputation at the shoulder-joint reported to the Surgeon-General from the late war, 591 recovered, 236 died, and in 25 cases the results are unknown, giving a mortality of 28.5 in the determined cases. The largest mortality was from amputations made in the intermediate period, and the smallest from amputations in the primary. The same relative safety of primary operations was shown in the case of shoulder-joint excisions.

Amputation of the Arm, including the Scapula.—This amputation was first performed by Cummings in 1808, for a gunshot injury. The patient made a complete recovery. Since the date of this operation, amputation has been made at the scapulo-clavicular articulation, or through some portion of the clavicle, about 14 times, and, with the exception of Mr. Fergusson's case, in which he operated for a malignant disease of the scapula, I do not know of one who has died either directly or indirectly in consequence of the operation.[1]

On the 12th of December, 1870, I operated on George Hanna, of Barton, N. Y., by amputation of the arm and scapula. The history of this case is as follows:—

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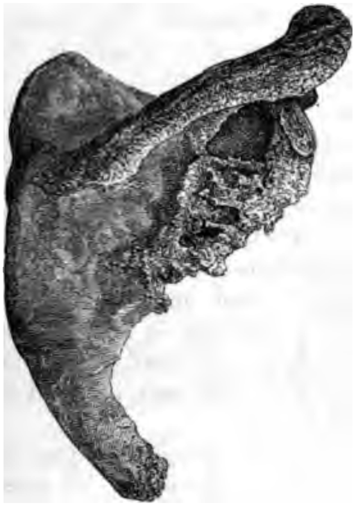
[1] *New York Medical Journal*, January, 1862, p. 433, Dr. Rogers' tables.

Fig. 149.



Scapula of George Hanna.

In September, 1864, Hanna was hit upon the back, near the lower angle of the right scapula, by a hard lump of earth, causing severe pain for several hours. Two weeks later the same point was again injured by the chafing of a rope in supporting a bale of hay, and on the following morning he noticed a very hard swelling at the point of injury, of the size of a hen's egg. The tumor continued to increase in size, unaccompanied with discoloration, until the 15th of February, 1865, when it was as large as a quart bowl. At this time the tumor, with a portion of the anterior border of the scapula, was removed by the knife. The wound healed in 28 days, and his health remained as good as before the operation. January, 1868, after exposure during very inclement weather, the tumor began to appear again, and on the 12th of February following it was removed by the knife, with a small portion of the scapula. Before this wound had closed a swelling occurred upon the upper arm, which, being opened, gave exit to a large quantity of gelatinous matter; and at the same time the tumor began to reappear over the scapula. From September, 1868, to July, 1869, the tumor was treated by setons and by escharotics, such as nitric acid, chloride of zinc, carbolic acid, etc. In July, 1869, another attempt was made to remove the tumor with the knife, but the bleeding was so free as to cause an apprehension that the patient would die in the operation, and no portion of the tumor was removed. From this time the mass continued to grow, and to extend along the back and arm; occasionally elevated points would open spontaneously and discharge a gelatinous material, sometimes a serous fluid, and along the margin there were points where the fluid discharged appeared like pus.

The operation consisted: first, in making a large flap from the inner and upper part of the arm, of about seven inches in length and four or five inches in width. The base of this flap corresponded to the axilla, and included the axillary artery, which was at once tied: second, the mass was exposed by incisions over the scapula, and the dissections were continued to its inferior and posterior margins: third, the scapula was lifted from below, and after having divided the attachment of its muscles at its base, it was forcibly torn up until the upper margin and the glenoid cavity were reached: fourth, the dissection was continued from without until the upper margin of the scapula was laid bare and its remaining connections were severed.

During the operation the subclavian artery was held under complete control, by Dr. Johnson of Waverley, by digital compression made above the clavicle. A large portion of the integument covering the scapula, being involved in the disease, was removed, and its place supplied by the flap obtained from the arm.

A letter from Dr. Johnson, dated May 5th, nearly five months after the operation, informed me that the wound had been healed some weeks, and that the cicatrix looked healthy, but that he was suffering from diarrhœa, with œdema of his extremities, and that the prospect of his recovery was not very flattering. On the 20th of the same month he died.

In regard to the nature of the tumor a difference of opinion has existed, even since its removal and its examination under the microscope by experts; and perhaps chiefly for the reason that the specimens examined were not in the most favorable condition to determine the character of their cell formations. For myself I regarded it as colloid; others believed it to have been fluid enchondroma.

Amputations of the Foot.

Amputation of the Toes at the Second and Third Phalangeal Articulations.—The phalangeal articulations of the toes have essentially the same anatomical structure as those of the hands, only that the bones are shorter, broader, and their articular surfaces especially are much more expanded. Owing to the general practice, also, of wearing narrow and short shoes, the joints are often deformed and their motions very much limited. Amputations, therefore, cannot be made to observe any absolute or even general rules. As in the case of the fingers, however, the lateral ligaments are the keys to the articulations.

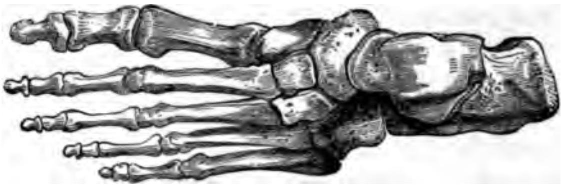
Amputation of the Toes at the Metatarso-phalangeal Articulations.—In general the same anatomical arrangements obtain here as in the corresponding phalanges of the hands, except that the joints are larger, they are often deformed, in many cases partially anchylosed, and it is therefore impossible to flex them to a right angle. Consequently the rules for amputation given for the corresponding bones of the fingers must be in some degree modified to suit the exigencies of the case. The modifications required will readily suggest themselves.

The accompanying wood-cut represents a congenital hypertrophy of the second toe, for which the author amputated at the metatarso-phalangeal articulation when the lad, who was the subject of the deformity, was nine years old. In the second wood-cut is shown the result of the operation. (Figs. 184 and 185, p. 401.)

Amputation at the Tarso-metatarsal Articulation.—This is a complicated and irregular articulation, formed by the juxtaposition of nine bones. It is arthrodial in its character, its motions being limited almost entirely to the feeblest flexion and extension, and an equally slight sliding motion upon nearly plane surfaces. Its ligaments, therefore, which cover in the whole length of the dorsal surface, are close and compact, and neither present in themselves any guides to the articulations, nor do they allow the joints to open sufficiently to indicate their positions.

No one would think of entering these articulations from the plantar surface, since in this direction they are peculiarly inaccessible, and the principal flap must be made from this surface.

Fig. 150.



Skeleton of Foot.

On the tibial, or inner side, occasionally not much difficulty will be experienced in finding the point where the metatarsal bone of the great toe articulates with the cuneiform internum. In most cases, however, the articulation cannot be easily traced.

It is only from the outer, or fibular side that the surgeon may approach this difficult operation with an assurance of success; employing as his guide the proximal end of the metatarsal bone of the little toe, which receives the insertion of the peroneus tertius and brevis. Lisfranc and Ziegler have seen the posterior tubercle of the metatarsal bone of the little toe, extending backwards toward the heel half and three-quarters of an inch; and it has even been found prolonged in this direction so as to articulate with the cuboid. In such a case the joint could not be entered from this point, except after first having sawn through the bone; but such abnormities are rare.

The mode of procedure in amputation at this articulation will be as follows: Commencing, in the case of the right foot, on the outer margin, at the tarso-metatarsal articulation of the little toe, carry the knife across the dorsum of the foot in the line of a curve, with its convexity forwards, and terminate this incision at the tarso-metatarsal articulation of the great toe, on the inner side. This latter articulation is, in adults, about three-quarters of an inch farther forwards than the corresponding articulation of the little toe. Prolong the two extremities of the incision toward the heel, on the inner and outer margins of the foot, half an inch, in order to expose the articulation more fully. This is especially necessary on the outer side, so that the "key" can be the more easily found. Place the knife upon the outer margin of the foot, a few lines posterior to the tubercle on the proximal end of the metatarsal bone of the little toe, and cut with firm pressure the tendons of the peronei, and the muscular bundle which forms the outer margin at this point. Now the "key," namely, the flat dorsal ligament, which connects the cuboid with the last metatarsal bone, will be fully exposed. It is not necessary that it should be seen and recognized, for it can be certainly cut by carrying the knife from this point obliquely forwards, over the top of the foot, in the direction of a line which, continued, would traverse the metatarso-phalangeal articulation of the great toe. The entrance of the knife into the articulation will be facilitated by bending the metatarsal bone toward the sole. From this point the knife must be held a little less obliquely across the foot, dividing the dorsal ligament binding the cuboid to the fourth metatarsal bone; and if the end of the foot is flexed quite forcibly, the knife will, in the same line, enter the joint between the cuneiform externum and the third metatarsal bone. The knife will here be arrested by the metatarsal bone of the second toe, as it is prolonged backwards between the external and internal cuneiform bones, like a tenon in its mortice; its edge must therefore be directed backwards toward the heel, and carried in this direction two or three lines; but great care must be taken not to carry the knife too far, lest it should enter the articulation between the middle and external cuneiform bones. The next step of the operation is always difficult, namely, to enter the joint formed by the second metatarsal bone and the cuneiform medium, which is indicated faintly by two very slightly elevated transverse ridges, covered by a flat, smooth, shining ligament; between these ridges the ligament presents the appearance of a transverse white line, and this is the line of the articulation, into which the knife must be made to enter. Having traversed this articulation, the point of the knife must be thrust deeply between the inner (tibial) side of the second metatarsal and the outer side of the internal cuneiform bone,—the back of the knife being toward the heel of the foot,—and by depressing the handle the blade will divide not only the dorsal, but also the internal interosseous ligament lying very deep toward the sole of the foot, and which is in reality the strongest ligament connected with the tarso-metatarsal articulation. The internal cuneiform bone is about half an inch longer than the middle cuneiform; consequently, the articulation of the first metatarsal bone with the cuneiform internum is about half an inch farther forwards than the articulation of the second metatarsal bone with the cuneiform medium. A knowledge of this fact will enable the surgeon to find without delay the tarso-metatarsal articulation of the great toe, which he will recognize also by the slight epiphyseal elevation at the proximal end of the metatarsal bone. The line of direction of this last named articulation is slightly oblique, so that in following it to the tibial side of the foot the knife will incline a little toward the heel.

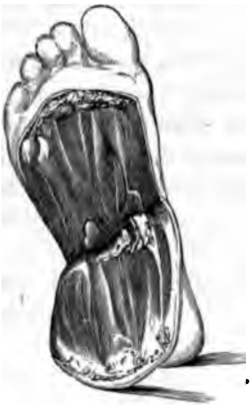
It only remains to complete the section of the interosseous and plantar ligaments, and to construct the plantar flap from the tissues upon the sole of the foot. This flap, which is alone to cover the end of the stump, must include nearly all the integument on the bottom of the foot as far forward as the interdigital commissure; or at least to within one inch of this commissure. To insure also a proper size and form to the flap, it ought to be cut from the surface, and not from within out, as has been generally recommended.

I have thought it necessary to extend the description of this amputation, because in several of the steps, as the careful student will observe, my directions differ from those given by Lisfranc, whose method has for a long time been accepted as the best which could be adopted. It will be especially noticed that I attach very little importance to the internal interosseous ligament, which Lisfranc regarded as the "key" to the articulation; indeed it was from his use of the term in this connection that I have borrowed it, and given to it a more extended application. If this ligament must be considered the key to this joint, it has at least one great disadvantage. It is very difficult to find.

Amputation at the Medio-Tarsal Articulation.—This articulation is formed by the astragalus and calcaneum on the one hand, with the scaphoid and cuboid on the other. Its character is essentially enarthrodial, and its motions, although limited, are quite distinct in all directions; the ligaments which immediately embrace the articulations are, therefore, not so short and compact as those of the tarso-metatarsal articulation, and the joint may be easily entered with a knife from almost any point except perhaps the plantar surface. The principal difficulty which the surgeon experiences is in finding a reliable *guide* to the articulation. The measurements made from the malleoli, and from other points, vary so much in different subjects as to be wholly untrustworthy. The only guide which under nearly all circumstances can be relied upon is the inner side of the scaphoid bone. This forms the only remarkable prominence on the inside of the foot below the ankle, and cannot be confounded with anything else, especially if we place the finger on this prominence and then alternately adduct and abduct the foot. We shall then observe that the only point of motion during this manipulation is just above this prominence; that is, between the scaphoid and the head of the astragalus. I have never found a subject so fat, or a limb so infiltrated with inflammatory effusions that the point of motion could not be distinctly defined, and that a knife could not be entered with certainty into the joint.

There are no ligaments on the inside of the foot between the astragalus and the scaphoid, and but one thin feeble ligament above, namely, the superior astragalo scaphoid.

Fig. 151.



Plantar Flap in Medio-tarsal Amputation.

Standing erect, the weight of the body falls to the inner side of the centre of the arch of the foot, consequently the foot is inclined to be pressed or "splayed" outwards, and this would be its constant position, were it not for the powerful muscles whose tendons pass behind the malleolus internus, and for certain strong ligaments. These ligaments—for the muscles do not interest us in this connection—are the deep and superficial layers of the internal lateral or deltoid, belonging to the ankle-joint. The deep layer passes from the apex of the malleolus internus directly to the astragalus. The superficial layer arises from the entire outer surface of the malleolus internus near its lower end, and is attached in a fan shape to the astragalus behind, to the calcaneum below, and by a broad, flat, and firm band to the scaphoid in front. This latter fasciculus, namely, that which attaches itself to the scaphoid, is the key to the joint.

The deltoid ligament is probably always ruptured in outward dislocations of the foot; and this will explain, much better than Dupuytren's theory, the consequent and often permanent splaying of the foot outwards. It is often strained in walking, in jumping, in dancing, etc., and in such cases the scaphoid seems to project unusually, or it becomes very tender in consequence of the inflammation developed in its periosteal coverings at or near the point of attachment of the injured ligament.

First step of the operation.—Seize the foot with the left hand—in the case of the left foot—and enter the bistoury over the centre of the tuberosity, or most projecting point of the scaphoid bone on the inner side, and carry it across in the line of a curve with its convexity forwards, terminating the incision at a corresponding point on the opposite side of the foot. Dissect up the dorsal tegumentary flap a short distance and divide the extensor tendons, etc., at its base. Prolong the incision on the inside of the foot a little toward the heel, so as to uncover completely the key to the joint.

The object in making this first incision below the articulation, forming thus a short flap which requires afterward to be dissected up to the joint, is to insure a sufficient dorsal tegumentary covering; but the same end may be attained, whenever the skin is not rendered too tense by swelling, by another and much more expeditious procedure. Thus, the foot being held at a right angle with the leg, while an assistant retracts forcibly the integument above the line of incision, the knife may be entered at once into the astragalo-scaphoid articulation on the inside of the foot, and from thence be carried directly across to a corresponding point on the outside.

Second.—Carry the knife across the articulation, while the foot is forcibly depressed, dividing the deltoid, the dorsal, and the interosseous ligaments. This latter has again been called the "key" to this articulation, solely perhaps because it is a strong and somewhat inaccessible ligament, and its section is demanded before the articulation can be freely opened; but it is never divided in the first steps of the incision into the joint, and it cannot be considered therefore as the key of the joint in the sense in which I have employed the term. It is not situated at the gate or entrance to the articulation.

Having traversed the astragalo-scaphoid portion of the articulation, if the foot remains at a right angle with the leg, the knife will readily enter and pass through the calcaneo-cuboid portion nearly in the same line in which it has hitherto been carried; but in general it is found most convenient to depress the foot in order to open the joint more freely; in doing so the calcaneum is made to project a little forwards, and the edge of the knife must be inclined forwards and carried through to the sole of the foot in this direction.

The plantar flap must be very long, and great care must be taken that it has sufficient breadth at its base. In order to secure this latter end, it ought always to be made by cutting from the surface, and not from within out.

In the description which I have given of this amputation, I do no claim to have modified materially the original plan of Chopart; it has been my purpose especially to throw some additional light upon the most important point, namely, the manner of entering the joint. I do not esteem the operation very highly, and from all that I have seen of its results I am not disposed to recommend it, unless it may be in some very rare and exceptional cases. I may say indeed that it is about the only amputation which I have never yet made upon the living subject. During the late war this operation was made, according to the statement of the Surgeon-General, 85 times; and there are several cases in the Army Medical Museum which exhibit the drawing up of the heel, a result which I have myself observed in all the cases which have come under my notice.

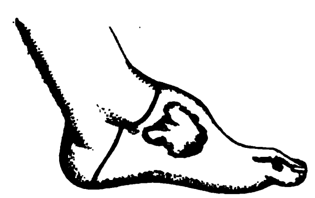
Amputation at the Tibio-tarsal Articulation—Ankle-joint.—The tibio-tarsal articulation is ginglymoid, and admits of no lateral motion; the astragalus being compactly wedged between the two malleoli. The articulation is supported and its luxation prevented by the capsule, the tendons and muscles which pass to the foot, the two malleoli and the ligaments. The capsule forms the most inconsiderable portion of this support. The muscles and tendons have their origins and attachments too remote to be of much service in this regard; except that the two strong tendons passing through the groove immediately behind the malleolus internus, when in action, contribute materially to the prevention of a luxation of the foot outwards. The two malleoli are very important supports to the joint, and this is especially true of the outer malleolus. There is no posterior ligament to the articulation; the anterior ligament is broad, long, and thin; while the external lateral ligament is composed of three rather narrow and not remarkably strong fasciculi. Finally, the internal lateral ligament (deltoid), which I have already described particularly in connection with the medio-tarsal articulation, is broad and strong, and constitutes the chief support of this articulation.

The deltoid ligament is, therefore, the key to this, quite as much as to the medio-tarsal articulation; and not only because it is the strongest, or that which most especially retains the bones in place, but also because, owing to the relative shortness of the malleolus internus, it is more accessible than the external lateral ligament; moreover, being composed at its origin of one continuous bundle of fibres, while the external ligament originates at three distinct points of the malleolus, it can be more easily divided. It has an advantage over the external ligament, also, in the fact that the malleolus internus being shorter, a section of the internal ligament, near its origin, enables the surgeon to carry the knife more easily to the top of the astragalus, and thus to complete the disarticulation.

The following is the method which I have preferred in this amputation:—

First.—The foot being held in a position of extreme extension, the point of the bistoury is introduced half an inch below the centre of the lower end of the malleolus internus—in the case of the left foot—and from thence it is carried over the top of the foot, in the line of a curve having a slight convexity downwards, to the anterior margin of the lower end of the malleolus externus. The object in commencing this incision half an inch below the malleolus internus is to preserve the symmetry of the transverse incision; and by terminating the incision, also, a little further forwards, to secure so much additional width to the base of the posterior or plantar flap. Upon the inner side I prefer to carry the incision farther back, that I may expose the deltoid ligament more freely to the knife. The knife, while traversing the top of the foot, may be pressed with sufficient firmness to divide the tendons and all the tissues down to the bone, including the anterior ligament and the capsule.

Fig. 152.

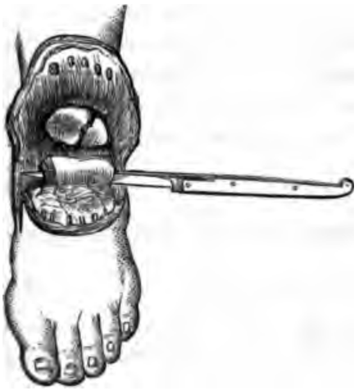


Line of Incision in Tibio-tarsal Amputation.

Second.—The leg being elevated and the foot flexed to a right angle with the leg, the bistoury may be placed firmly upon the point where the first incision commenced, and from thence be carried across the bottom of the foot, cutting to the bone and terminating where the first incision ended upon the outside. The lines of this second incision ought not to fall vertically from the malleoli, that is, not at a right angle with the sole of the foot, as this would give a redundancy of flap; it would also increase the danger of sloughing, and render the detachment of the flap from the calcaneum more difficult. It is better to carry the lines of incision from the two malleoli a little backwards, so that the knife will cross the bottom of the foot about one inch and a half farther back; and in the case of an unusually long heel it will be proper to carry the incision backwards two inches.

Third.—Expose the end of the malleolus internus fully, and introduce a strong, sharp bistoury half an inch below the malleolus, with the edge directed outwards toward the astragalus, and a little inclined upwards toward the lower end of the tibia, being careful not to project its point so far as to wound the posterior tibial artery; and then, while the foot is forcibly abducted, cut firmly, and with a slight sawing motion. This will sever the deltoid ligament and open the joint freely.

Fig. 153.



Tibio-tarsal Amputation.

Fourth.—The practice has been hitherto, in pursuance, I think, of the advice of Mr. Syme, to separate the lower flap from the calcaneum by dissecting from the bottom of the foot;

a method of procedure which I have found tedious and difficult. I prefer very much to make this dissection from above. Putting the foot again into a position of extreme extension, the knife will divide the external lateral ligaments, and by forcing the foot down the joint will be easily entered, and the dissection continued backwards over the top of the calcaneum toward the tendo-Achillis. The operator will find it necessary to discontinue occasionally the backward dissection, and to loosen, alternately on the right and on the left, the attachments of the integuments to the sides of the calcaneum, using great care now that by keeping close to the bone behind the malleolus internus, he does not wound the posterior tibial artery before it has given off the internal calcanean branches which supply the integument and cellulo-adipose tissue composing the posterior flap. Division of the posterior tibial at a point lower than this does not, as it has been affirmed to do, increase the danger of losing the flap, inasmuch as it receives no arterial supply from a lower source. Caution must also be used in dissecting backwards, over the top of the heel-bone, —especially where the tendo-Achillis is attached—to hug the bone closely, and thus to avoid all danger of opening through the integument.

Fifth.—Expose the two malleoli thoroughly, and saw them off on a level with the lower articular surface of the tibia, using great care again not to wound with the saw the posterior tibial artery. It is not necessary, nor is it useful, to remove any portion of the lower articular surface of the tibia, unless it is diseased.

If, after securing the arteries, any of the tendons are found projecting very much, or if they have been lacerated, cut them off close to the point where they emerge from their sheaths; but do not, for this purpose, draw them down forcibly, since in retracting, their divided ends will be carried up, and the danger of suppurative inflammation in the synovial canals will be thereby increased.

I have not found it necessary to establish an opening through the flap to secure drainage; but if this were deemed necessary, it ought to be made on the back of the flap, just opposite the point where the tendo-Achillis was attached, and where the tegumentary covering is the thinnest. A small vertical slit at this point might be harmless. An opening through the thick integument of the middle of the flap is not sufficiently depending for drainage when the patient lies in bed, and leaves a sensitive cicatrix in parts which are destined to support the weight of the body.

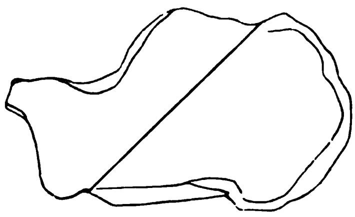
It seems to me proper to add in this connection that in all amputations of the leg at a point below its upper third, requiring the employment of a tourniquet, I have been able to diminish the loss of blood by applying this instrument to the popliteal artery rather than to the femoral. My practice is to construct a pad composed of a cotton roller folded upon itself, so that it shall be three inches wide by four inches in length, and about two and a half inches in thickness. This is placed lengthwise in the upper half of the popliteal space, and the strap is buckled over the pad and across the thigh, just above the patella. The frame of the tourniquet should be on the front of the thigh, underlaid with a few folds of bandage to prevent its injuring the skin. This will secure the artery perfectly, and leave the motion of the leg unembarrassed.

Results.—Dr. Stephen Smith, in the paper contributed to the memoirs of the U. S. Sanitary Commission, already referred to, concludes that amputation at the ankle-joint is 50 per cent. less fatal than amputation through the leg in its lower third, and a little more than one-third as fatal as all other amputations of the leg and foot; that they are three per cent. more liable to be followed by sloughing of the flap, and other conditions demanding re-amputation; that the stumps are far more serviceable for unassisted locomotion; and that they give a better support to artificial limbs.

Pirogoff's Osteoplastic Operation.—Pirogoff proposed to increase the length of the limb by saving a portion of the calcaneum. He claimed, also, for his operation, that it possessed an advantage over the tibio-tarsal operation of Syme, in that there was less danger of the loss of the flap by sloughing. His method is as follows:—

An incision is commenced close in front of the outer malleolus, and carried down to the sole of the foot, then across and upward to the opposite malleolus. This incision, which extends everywhere to the bone, is not vertical, but is so inclined as that it shall cross the sole of the foot at least one inch in advance of the malleoli. A second incision unites its two extremities with the first across the top of the foot, as in Syme's amputation. The joint being opened in front, according to the method already described in the tibio-tarsal amputation, the upper portion of the calcaneum is exposed, when the saw is applied obliquely to the calcaneum in front of the attachment of the tendo-Achillis, and the bone divided in such a manner that the section shall correspond to the incision upon the sole of the foot. The malleoli, with a thin section of the lower end of the tibia, are then removed, the flap containing the section of bone brought up, and united by sutures and straps.

Fig. 154.

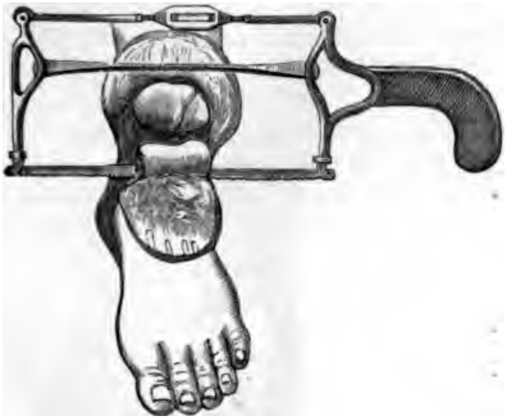


Line of Section of the Bone.

Results.—Necrosis of the divided calcaneum is an occasional, yet rare, result of this operation. The stump is usually firm and tolerant of pressure; and, as in Syme's operation, the patients are often able to walk, and even run and leap, without the aid of an artificial foot. Mr. Hudson is of opinion, however, that the base of support is too low in

Pirogoff's operation to allow of the proper adaptation of an artificial foot.

Fig. 155.



Pirogoff's Operation.

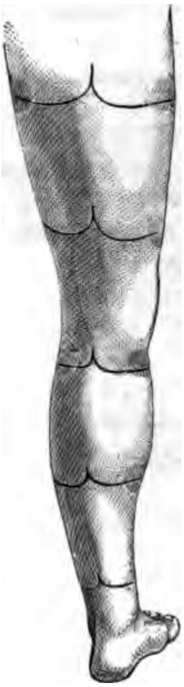
Amputations of the Leg.

Amputation of the Leg in Continuity.—In the lower third of the leg the circular amputation ought, in general, to have the preference. In making this operation, whether through the leg or thigh, I have of late practised the following method:—

The knife, instead of making the complete circuit of the limb in a line at a right angle to its axis, is carried upwards upon the posterior aspect through a short curve of one, two, or more inches; the opposite extremity of the circular incision terminating in the same manner, and at the same point. The advantages of this method are, the greater ease with which the skin is rolled back, rendering the operation admissible even in those portions of the limb which are conical, and the free opening which is left in the most depending part of the stump for the passage of the ligatures and the evacuation of blood and pus. The integuments being brought together also from side to side, a fold is formed anteriorly which obviates in a great measure the danger of a protrusion of the spine of the tibia.

In the middle and upper portions of the leg it is perhaps a ma indifference whether we adopt the flap or circular method. Tl

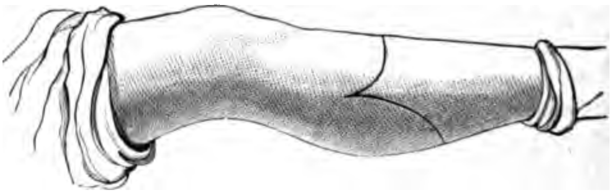
Fig. 156.



Author's Lines of Incision for Circular Amputation of Leg or

operation is made as follows. The limb being elevated a few mo before tightening the tourniquet, in order to drain it of its bl completely as possible, the surgeon with a common scalpel ma

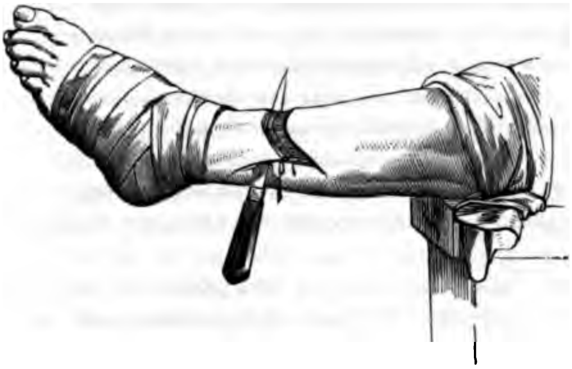
Fig. 157.



Flap Amputation of Leg.

short anterior flap, with its convexity directed downwards, and ex ing from the outer and posterior margin of the fibula on the one to the inner and posterior margin of the tibia on the other. Thi entirely tegumentary, and not more than one inch and a quarter in length, is immediately raised by moderate traction and a few strokes of the knife. The second and principal flap is then made with an amputating knife, by transfixing the leg close under the bones, the points of entrance and of exit corresponding to the two extremities of the first incision; and from thence the knife is made to descend obliquely to the surface, or with a gentle curve, forming a flap of from three to four inches in length, more or less, according to the diameter of the limb. In dividing the bones in this, as in all other amputations of the leg, the saw should be so applied as to sever the fibula first, and care must be taken to divide the fibula at a point at least as high as that at which the tibia is divided. In order to prevent subsequent protrusion of the bone, it is advisable, generally, to remove with the bone-cutter the sharp point of the spine of the tibia.

Fig. 158.



Flap Amputation of the Leg.

Amputation at the Femoro-tibial Articulation—Knee-joint.—The great size of this ginglymoid articulation, its latitude of motion, its lack of either bony or muscular support in the direction of its circumference, together with the fact that it is destined to sustain the whole weight of the body, demand stronger ligaments and a more complicated arrangement of their fasciculi than are required in any other articulation. Nevertheless, the thinness of its exterior coverings, and the large size of its various anatomical parts, render it easy to determine the position of its articular surfaces, and to accomplish its disarticulation with the knife.

There exists, therefore, no special necessity for determining what ought to be regarded as the key to this joint; since the most inexperienced surgeon would scarcely fail, whatever mode of approach he might adopt. It is rather, then, for the purpose of rendering complete this series of observations, and because I have some useful suggestions to offer in relation to the details of the operation, that I make any allusion to the anatomy of the joint.

half of the capsule, the external lateral ligaments, and the outer hamstrings. The interarticular cartilages must remain attached to the tibia.

Third.—Direct the assistant to flex the leg upon the thigh as far as possible, so as to bring into view the crucial ligaments; divide these with the point of the knife, and cut slightly the posterior ligaments.

Fourth.—Direct the assistant to place one hand behind the knee and to draw the upper part of the leg forwards so as to open the joint posteriorly. Introduce the blade of the knife behind the head of the tibia, with its edge directed downwards in the plane of the shaft of the tibia; carry it in this direction two inches, then turn the edge directly backwards toward the back of the leg and cut out.

If the knife is made to pass directly through the soft parts, posteriorly, in the direction of the articular surfaces, the popliteal artery will be so drawn up and concealed in the upper angle of the wound that it will be difficult to seize it. Moreover, the directions which I have given for making the first incision, and which are necessary to insure a sufficient covering, imply the existence of a short posterior flap; the commencement of the oval incision, on the back of the leg, below the hamstrings, being at least two inches below the head of the tibia.

The question whether the patella should be removed in this amputation has been much discussed. The advantage of not removing the patella consists solely in the fact that the quadriceps acts with more power when it is retained. On the other hand, in consequence of being retained, the anterior flap must be from one to two inches longer; and this is rendered necessary for two reasons: first, because of the additional surface required to be covered; and second, because the quadriceps retains its full power to act upon the tegumentary flap and to displace it upwards.

If the patient is in good health, and the integuments which are to compose the flap are thick, vascular, and in no way injured or diseased, and if the end of the femur is not very large, it may be proper to leave the patella in place; but if opposite conditions obtain, or if, the flaps having been formed, it is found that they do not close easily and without force over the end of the femur, then the patella should be removed. In cutting away the patella the surgeon needs to exercise some care to keep close to the bone, and not to remove or wound any portion of the adjacent soft parts.

Experience has shown that it is not necessary to excise the cartilage of incrustation, since, after exposure, it undergoes rapidly certain pathological changes; and flaps unite to exposed articular surfaces almost as speedily as union is known to occur in other wounds. It only remains to tie the popliteal artery, and to close the wound by laying the long anterior flap over the end of the stump and securing it in place.

It will be observed that I have described very nearly, in so far as the form of the first incision is concerned, the oval operation of Baudens; but I have modified all the incisions in several points; and I have also attempted to render its description more precise than has been done in any of the treatises which profess to describe Baudens' method, without which precision the results are likely to be very unfortunate, or at least unsatisfactory.

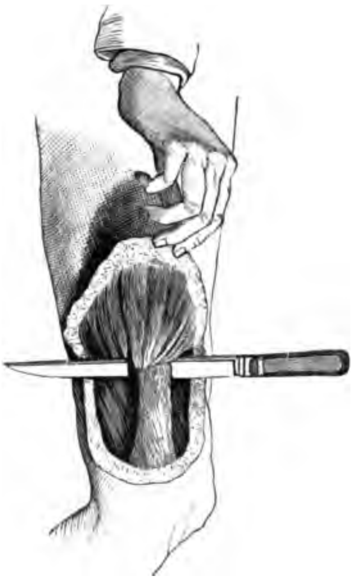
Results.—Dr. Brinton, of Philadelphia, has collected the histories of 164 cases of knee-joint amputations, in 111 of which recovery took place and 53 died, a mortality of 32½ per cent. Of 189 cases recorded in the office of the Surgeon-General U. S. A., 106 died; a mortality of 56.6 per cent. Dr. Markoe, of this city, found in a record of 49 cases, 17 deaths, giving a rate of mortality of 37 per cent. As usual, the reports of cases in civil practice give a much lower rate of mortality than the cases drawn from military records; in part because the circumstances are more favorable, but also in part because in civil practice unsuccessful cases are much less likely to find a record.

Amputations of the Thigh.

Amputation of the Thigh in Continuity.—Most operators have preferred the flap method in amputations of the thigh in continuity. There are, however, many cases presented in which the circular incisions possess an advantage. When the limb is very large, either in consequence of unusual muscular development, from an abundance of adipose tissue, or from serous infiltrations, the pendulous masses formed by the flap method often give rise to excessive suppuration and pyæmia; but in thighs of moderate or average size the flaps generally do well.

When the flap method is chosen, lateral flaps are to be preferred in the lower third of the femur, on account of the insufficiency of muscular tissue upon the anterior and posterior aspects of the limb; but in the upper and middle thirds anterior and posterior flaps furnish the best results, for the reason that when lateral flaps are made in these regions the bone is apt to protrude at the upper angle of the wound, and cause serious trouble. In amputations made through the upper third of the limb, the femoral artery must be controlled by pressure made with the

Fig. 159.



Amputation of Thigh in Lower Third.

thumb; one hand of the assistant grasping the trochanter, while the thumb rests upon the artery as it passes over the pubes, re-enforced by pressure made with the thumb of the opposite hand. In amputations of the middle or lower thirds, the tourniquet will be applied to the femoral artery in Scarpa's space.

The double antero-posterior flap is most rapidly and conveniently made as follows:—The muscles and integument being lifted from the bone with the left hand, the heel of a long, straight, single-edged amputating knife is placed upon the front of the thigh, and while it is drawn from the heel to the point, an oval flap is made extending to the bone, and in length a little less than the semi-diameter of the limb. The point of the knife, then, without leaving the limb, is entered below the bone, and, being thrust to the opposite side, is carried downwards and toward the surface, forming a flap in length something more than the semi-diameter of the limb. The flaps being reversed, the muscles are detached thoroughly from the femur, and its section accomplished by the saw. When the arteries are secured and the wound closed, the stump should be laid upon a soft and slightly elevated inclined plane, so as to relax the muscles upon the front and inner portions of the limb.

Amputation at the Coxo-femoral Articulation—Hip-joint.—The coxo-femoral articulation is enarthrodial, but its range of motion is considerably less than that of the shoulder-joint, owing to the greater depth of its socket, and to the fact that its capsular ligament, especially in front, has less relative length or redundancy. In fact, while the head of the humerus is retained in position chiefly by the surrounding muscles with their tendons, the head of the femur is retained in place almost exclusively by the elevated margins of the acetabulum and by its ligaments, to which may be added, as in other articulations, the force of atmospheric pressure.

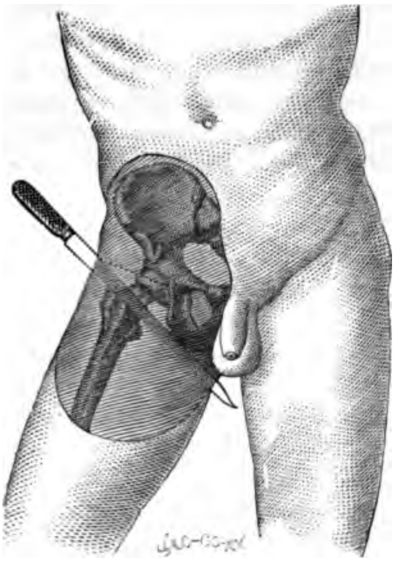
The round ligament has no power to retain the femur in position, or to limit its motions, except in extreme abduction or adduction. The capsular ligament extending from the acetabular margins to the inter-trochanteric lines is thick and strong, especially above and in front. The ilio-femoral is also a remarkably strong band of fibres arising from the anterior inferior spinous process of the ilium, and which, as it descends obliquely forwards and downwards across the head and neck of the femur, attaches itself to the outer surface of the capsular ligament, and finally to the anterior inter-trochanteric line near the trochanter minor. It is, therefore, an accessory ligament to the capsular, designed to reinforce its anterior and inner wall.

If the anterior and internal portion of the capsule be cut, together with the ilio-femoral ligament, and the thigh be forcibly abducted and thrown backwards, a dislocation is effected with great ease. This portion of the capsule, with the ligament above named, constitute, therefore, the key to the joint.

Single Antero-internal Flap Method.—A majority of practical surgeons have, I think, given the preference to some form of the flap amputation. It is preferred by Langenbeck, Guerin, Malgaigne; and during the late war most of our surgeons adopted this method in some of its modifications. Few surgeons, however, have ever made a sufficient number of hip-joint amputations upon the living subject, to have determined in this manner the relative merits of the different modes which have been recommended. In the single amputation at the hip-joint upon the living subject which I have had occasion to make, for special reasons a different method was chosen. Our appreciation of the different procedures must, therefore, be founded upon experiments made upon the cadaver; of this source of information I have availed myself; and, after having practised all the plans recommended many times, I have fully adopted the following modification of the anterior flap operation:—

First.—Supposing it to be the right limb which is to be amputated, the patient is placed upon his back, with the right natis resting upon the lower end of the table, on the side of the table corresponding to the right side of the patient.

Fig. 160.



Anatomy of Hip-joint, and guides for the Knife.

The thigh is then slightly elevated (flexed), adducted moderately, and slightly rotated inwards—this position having the effect of rendering the head of the femur less prominent, and, at the same time, of carrying the femoral vessels and the anterior crural nerve more forwards, so that the point of the knife can pass safely between the head of the bone and the vessels.

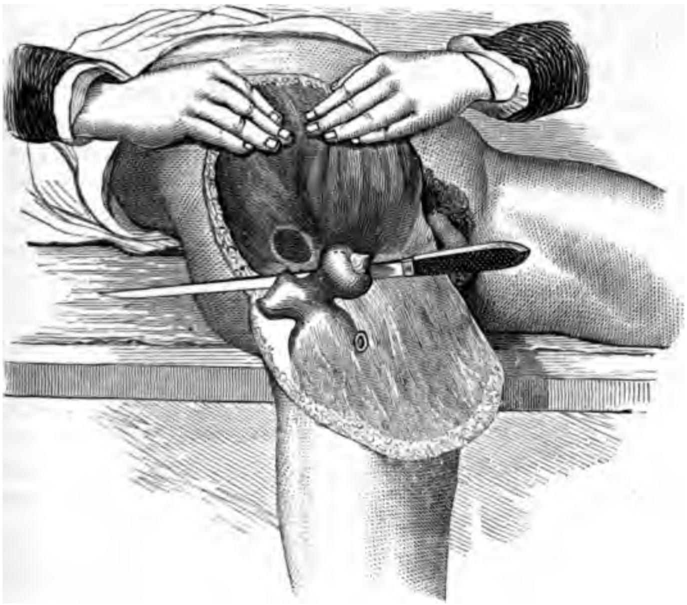
A tourniquet being applied to the abdominal aorta, and the femoral artery being compressed by an assistant as it passes over the brim of the pelvis, the operator, holding in his right hand a straight, single-edged amputating knife, having a twelve or fourteen inch blade, introduces its point just above, and one inch in front of the trochanter major, the edge of the knife being directed downwards, in the line of the axis of the limb. From this point the knife is made to penetrate transversely, and with a slight inclination backwards, so as to strike the head of the femur in its upper half and near the upper margin of the acetabulum. By inclining the point also, as directed, a little backwards, the head of the femur will be struck rather upon its outer aspect, and not upon its most prominent and anterior aspect. The point of

knife having entered the capsule, and penetrated slightly the head
the femur, will be arrested; the handle of the knife being carried
ard the head of the patient, the point will descend over the head
the femur to the neck, cutting the capsule as it descends; thrusting
point across the limb, it will penetrate in front of the neck,
ler the anterior portion of its capsule. Then elevating the handle
he direction forwards, as much as the skin and fascia lata will per-
, and at the same time inclining the handle toward the head of the
ient, the point, under steady pressure, will continue to descend under
ilio-femoral ligament, and the conjoined tendon of the psoas mag-
and iliacus internus, and finally emerge well back and below the
erosity of the ischium.

Vith a sawing motion the surgeon enlarges the incision downwards
ng the front of the trochanter major and neck, until sufficient space
ade to allow a second assistant to introduce the four fingers of each
d into the anterior and posterior wounds, and to seize the femoral
els between his thumbs and fingers. The first assistant, pressing
n the vessels over the brim of the pelvis, must not withdraw his
sure until the second assistant has satisfied himself that he has
n in his grasp.

he surgeon then rapidly completes the section of the anterior flap,

Fig. 161.



Compression of the Femoral Artery in the Flap.

ng the edge of his knife a little to overcome the elevation of the
anter minor, and carrying it down close to the shaft of the femur

far enough to make a flap of from five to seven inches in length—more or less, according to the diameter of the limb—and finally bringing the edge of the knife to the surface obliquely.

Second.—An assistant, grasping the knee and leg, rotates the thigh outwards, while he forcibly abducts and carries it backwards over the corner of the table and toward the floor.

If, in the first step of the operation, the point of the knife has struck skilfully the capsule covering the head of the bone, the disarticulation may be accomplished by the manœuvre just described. In other cases it will be necessary for the surgeon to apply the knife to the capsule, and for this purpose a large scalpel is the most convenient—dividing the capsule first transversely over the most projecting portion of the head, and then longitudinally in the direction of the axis of the neck; extending this last incision well down upon the neck. The round ligament, if not already torn, is then to be cut.

Third.—The disarticulation being effected, the centre of the amputating knife is to be passed above the head of the bone, and the section of the parts posterior to the articulation completed by a sawing motion, the knife being made to emerge below in the gluteal fold.

The arteries having been tied, the large anterior flap is permitted to fall back, and is made fast with sutures and adhesive strips; the whole being secured by a roller.

Remarks.—If time is no element of consideration, no doubt the operation might be made with some less chance of hæmorrhage by securing the femoral artery, just below Poupart's ligament, before commencing the amputation, as has been recommended by Valentine Mott, Delpech, Blandin, and others. Larrey advised to tie both the artery and vein; as a substitute for which procedure it might be proper to apply to one or both of these vessels a ligature of reserve, which could be removed when the operation was completed.

The instructions given by Fergusson and others, to introduce the point of the knife "about midway between the trochanter major and the anterior superior spinous process of the ilium, keeping it rather nearer the latter than the former," and then "run it across," is unsafe. The point of the knife is in danger of passing above the head of the femur, and even of penetrating the belly and wounding the iliac artery and vein; and especially if we add to this error in introducing the knife the instructions given by Guerin, to carry the point of the knife a little upwards. This accident has actually happened with me in making the amputation upon the cadaver according to the rule given by Guerin. It will be seen, therefore, that I have modified this step of the operation. Certainly it may be awkward to dislocate if the operator strikes the capsule too low, but of the two evils this is much the least.

In the final incision, if we cut from without, that is, from the surface, holding the point of the knife, at first, directed perpendicularly upwards between the thighs, it will be found very inconvenient to bring it downwards and outwards so as to sweep well around the thigh, on account of the proximity of the opposite thigh; and the operator will be obliged, generally, to apply the knife two or three times to complete the section. All of this embarrassment is avoided when this incision is commenced, as I have directed, from above the dislocated bone; but greater care has now to be exercised, in completing the section, that the knife falls exactly into the gluteal fold, and neither above nor below this point.

Results.—We are indebted to Dr. Otis, of the U. S. Army, for the most complete and critical analysis of all, or nearly all, the hip-joint amputations hitherto made for gunshot injuries, including also a summary of the cases reported from civil practice.[1]

Setting aside certain doubtful cases, the total number in military practice up to the period of the late civil war in this country was 108, and the recoveries 10,—a percentage of mortality of 91.66. It is claimed for but one of the successful operations that it was primary—a case reported by Larrey; but the exact period at which the operation was made is somewhat doubtful. The operations made in civil practice present a much more favorable result; since of 111 recorded cases, only 65 died, and 46 recovered,—a mortality of 58.56 per cent. It is very properly suggested by Dr. Otis, that this discrepancy in regard to the results obtained in military and civil practice may be in part due to the fact that in the latter case all the unfortunate cases have not been published. Of the cases published also in civil practice, the records are so scattered that very many of them have probably not been collated; and as an example I may mention a case of my own, which terminated fatally on the eighth day, reported to the New York Pathological Society, September 26, 1866, and published with the transactions of the Society in *The Medical Record* of New York. This case does not appear in the enumeration made by Dr. Otis.

During the war of the rebellion there were 66 amputations at the hip-joint performed on account of injuries inflicted by weapons, or of lesions consecutive thereto. Of the 25 primary amputations, which, according to the classification adopted by Mr. Otis, included all within the first twenty hours, 22 died and 3 recovered; a mortality of 88 per cent. Of 23 intermediary, all died. Of 9 secondary, 7 died; a mortality of 77.7 per cent. Of 9 reamputations, 3 died and 6 recovered; a mortality of 33.3 per cent.

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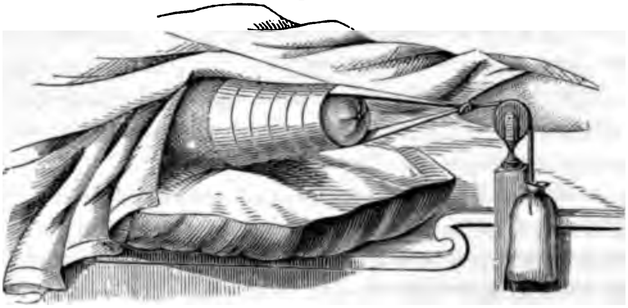
[1] Circular No. 7, War Department, Surgeon-General's office, Washington, July 1, 1867. See also for corrected report, Part III., Surgical History of the Civil War.

I have thought it proper to introduce here a wood-cut illustrating a mode of making extension upon the flaps by adhesive plaster, when, after amputation, the flaps retract or are destroyed by gangrene, first employed by Dr. A. H. Smith in the U. S. Hospital at Frederick City, Md., in 1862.

Fig. 162.



Extension of Flaps by Adhesive Plaster.—Hodgen.

CHAPTER XIX.

EXCISIONS.

SECTION 1.—GENERAL CONSIDERATIONS.

EXCISION of bones, practised more or less from the earliest periods, has assumed its chief importance only within the last few years, and it may therefore be regarded as one of the improvements of modern surgery.

Excisions are naturally divided into operations made in continuity, or through the shafts of long bones; operations in contiguity, or at the articulating surfaces; and operations involving the removal of entire bones. These operations also, like amputations, may be immediate, primary, intermediate, or secondary.

Immediate and primary operations are to be preferred in all recent injuries demanding excision. It happens, nevertheless, owing to indecision on the part of the surgeon, or to the existence of a rational doubt as to the proper course to pursue in the first instance, that these operations are often delayed; but rarely, if ever, ought excision to be practised during the intermediate period; and the longer the operation can be properly delayed in the secondary period, the better will be the result, not only on account of the less danger of inflammatory reactions when the system has become tolerant of the local disease, but especially because reproduction of bone is then more likely to be complete.

Resection of joints for caries and other similar chronic affections, ought never to be made while the joint surfaces, or the adjacent tissues, are in a state of active inflammation.

Children, and especially infants, exfoliate and extrude necrosed bone more rapidly than adults; at these periods of life, therefore, excision can sometimes be properly deferred in the expectation that nature will speedily accomplish the cure; when, also, in the case of children, through the interposition of an operation, or spontaneously, the dead bone is removed, the repair is usually rapid and often complete. In operations upon children, and upon all persons who have not attained their growth, it is desirable, if possible, to avoid the removal of an entire epiphysis, since the longitudinal growth of bone is carried on chiefly through the cartilage interposed between the shaft and the epiphysis, and its removal will in some measure retard its subsequent growth. According to the observations of Humphry, the two epiphyses of the long bones do not take an equal share in this process of development; thus, for example, the upper epiphysis in the humerus and tibia, and the lower epiphysis in the femur and radius, are the most important in this regard.

Osseous regeneration after sub-periosteal resection, especially when the periosteum is in a pathological condition, as for example when, in consequence of pre-existing periostitis, it is already in a state of hyperæmia, has been often observed. So long ago as 1850, as I shall mention more particularly in connection with excision of the phalanges of the fingers, I had seen under these conditions an entire phalanx reproduced. M. Ollier has, however, lately presented to the Academy of Sciences at Paris two examples of reproduction of the extremities of bones at the elbow-joint, including tuberosities and olecranon, verified in the autopsy. M. Willième has also reported one example of a similar reproduction after a primary resection at the elbow-joint, but which has only been verified by an examination of the limb during the life of the patient and four years after the resection. Recently, after a Syme's amputation, made for the removal of a diseased foot, I have found a large portion of the os calcis reproduced in the flap.

Ollier has observed that the osseous reproductive properties of the periosteum are greater in the case of the long than of the short bones; that the forms of joints are better preserved after sub-periosteal section; that the chances of subsequent shortening of the limbs are thus diminished, and finally that the danger to life is less than when the periosteum is removed with the bones. This latter proposition, it is proper to say, is supported mainly by observations made upon the lower classes of animals.

Conditions demanding Excision.

In general it may be said of excisions of bones or of joints, as has already been said of amputations, that they are admissible only as a last resort, when all other measures have failed, or promise to fail, in accomplishing a cure. They hold the same relations to therapeutics and to mechanical appliances as do amputations, for which latter they are regarded as substitutes. Whenever the question of the necessity of amputation arises in any given case, the further question may also be considered, whether excision may not be substituted, and a mutilated but somewhat useful limb be preserved. There are many conditions in which the substitute will be promptly rejected, as for example in all cases of malignant diseases involving the bones, and in a large class of extensive injuries involving important blood-vessels, nerves, and bony structures; but conditions will often be presented, especially in the case of certain joints, in which the propriety of excision will be manifest, as for example in certain recent injuries, or in caries or necrosis involving articulations, but limited to the neighborhood of the joints. The conditions demanding excision will, however, be more particularly considered in connection with the regions in which the operations are required.

Instruments required in Excision.

Fig. 163.

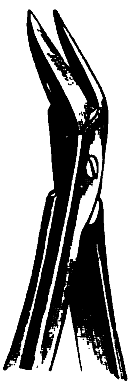


Fig. 164.

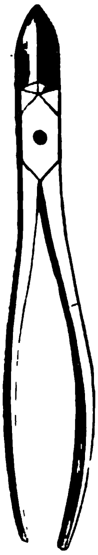
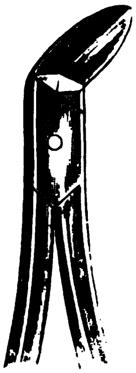
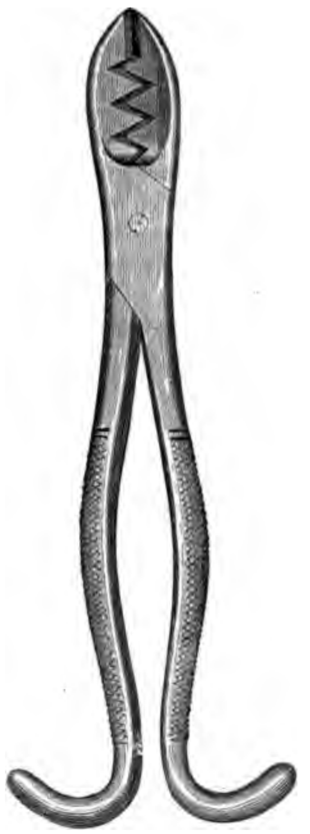


Fig. 165.



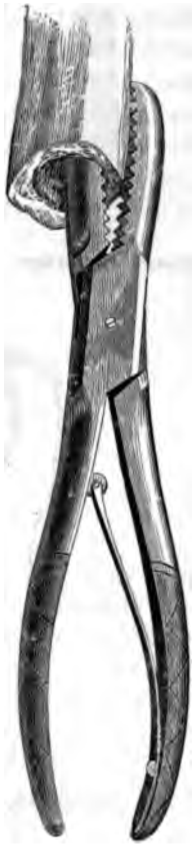
Bone cutters.

Fig. 166.



The author's Serrated Bone-cutter. Less than one-third of the actual size.

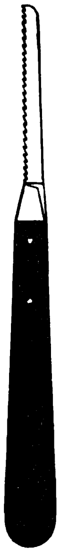
Fig. 167.



The author's Bone-forceps. Half the actual size.

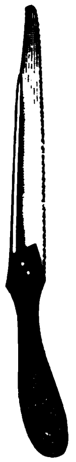
The operations of excision are exceedingly varied and often complicated, so that the number and character of the instruments to be employed must be determined in a great measure by the nature and situation of the lesion, and by other circumstances connected with the case. There are a few instruments, however, not usually found in operating-cases, which are so generally useful or necessary that it w be proper to mention them; such for example as metallic retracto a variety of straight and curved bone-cutters; steel chisels and gouge a metallic hammer; strong forceps for holding the bone; a cartila

Fig. 168.



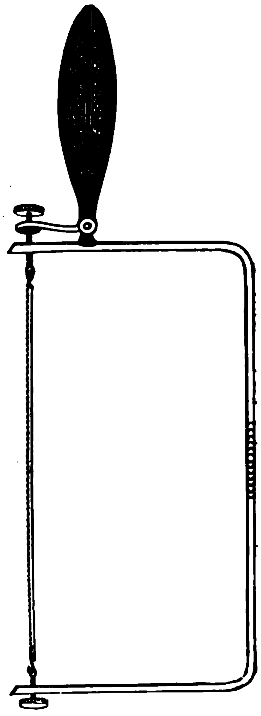
Narrow, straight Saw.

Fig. 169.



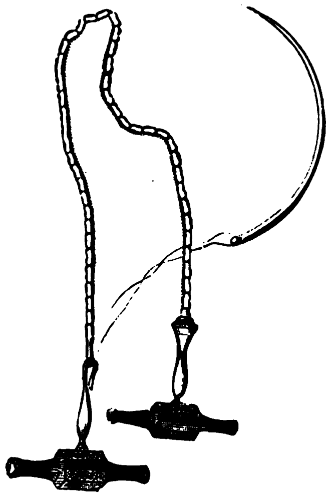
Movable-back Saw.

Fig. 170.



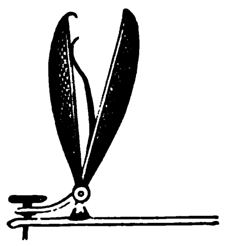
Symanowsky's Saw.

Fig. 171.



Chain Saw.

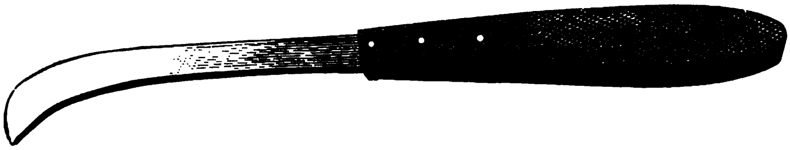
Fig. 172.



Handle of Symanowsky's Saw.

knife; a narrow straight saw, or a saw with a movable back; a S manowsky saw; a chain-saw, with Tiemann's rotating handles; instrument for passing the chain-saw; bone-drills; trephines; a pe osteal elevator, or periostotome. The periostotome represented in the accompanying wood-cut, one-half its actual size, is preferable to any which I have seen. Those which are smaller, and which have two cutting extremities with the handle in the middle, are liable to the objection that they cannot be grasped so firmly, and the end of the instrument is apt to press painfully upon the hand of the operator.

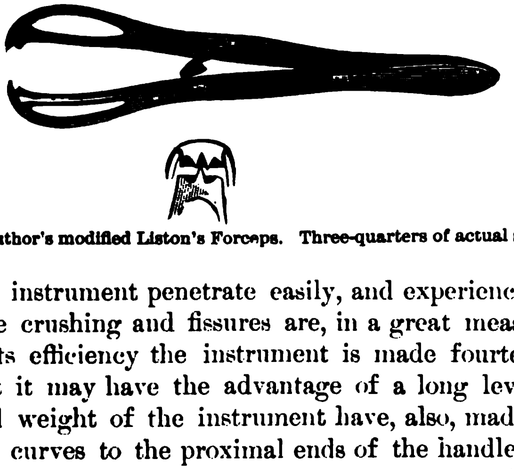
Fig. 173.



Periostotome.

The "serrated bone-cutter," represented above, was devised for the especial purpose of cutting large bones. The ordinary bone-cutters sometimes penetrate the outer lamellæ of the bony structure with difficulty, and the great force required to accomplish this causes fissures and comminution of the fragment remaining. It is true, however, that we seldom have occasion to apply the bone-cutter to large bones which are not previously softened by inflammation or caries, but even under these circumstances the same accidents are liable to occur. The sharp points of the serrated instrument penetrate easily, and experience has proven that by its use crushing and fissures are, in a great measure, avoided. To increase its efficiency the instrument is made fourteen inches in length, so that it may have the advantage of a long lever. The unusual size and weight of the instrument have, also, made it necessary to give abrupt curves to the proximal ends of the handle, by which it may be suspended perpendicularly over the hands in cutting.

Fig. 174.



The author's modified Liston's Forceps. Three-quarters of actual size.

Although it is somewhat out of place, I desire to call attention to an improvement upon Mr. Liston's artery forceps which has been made by Mr. Tiemann at my suggestion. A serrated surface has been placed back of the small teeth at the extremity, by which the hold upon the artery is made more secure. The instrument is also lighter, and its distal extremity more abrupt than those known here as Liston's forceps.

SECTION 2.—SPECIAL EXCISIONS.

Excisions of the Upper Extremities.

Excisions performed upon the upper extremities, whether in continuity or contiguity, have presented the most satisfactory and encouraging results. It must not be forgotten, however, that the results of amputations in the upper, contrast favorably with the results of amputations in the lower extremities; and that, without resorting to either excision or amputation, remarkably good results are sometimes obtained in the case of the upper extremities, after the most terrible accidents.

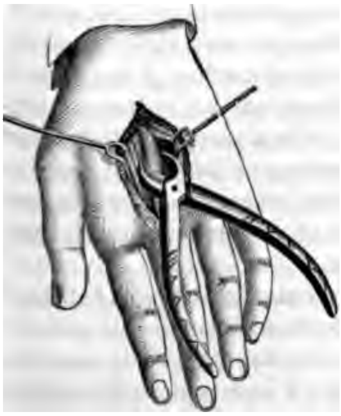
Excision of the Phalanges of the Hands.—Excision of the last phalanx entire is frequently rendered necessary in consequence of a felon; and in some cases of onychia osteosa, where the periosteum has been preserved, the phalanx has been reproduced. One example of this kind is reported in the *Buffalo Medical Journal* for May, 1850, in which, a few months after I had removed the bone entire, it was found to be reproduced of nearly its original size and shape, and with the motions of the joint unimpaired. Since then a number of similar examples have been recorded by surgeons.

Removal of any considerable portion of the first or second phalanges in continuity usually results in a fibrous or ligamentous union, and the finger is rendered useless. Excision is not, therefore, here—except perhaps for the removal of a small spiculum of bone—a proper substitute for amputation; but I have met with examples of compound dislocations of the metacarpo-phalangeal articulations of the thumb, and with old, unreduced dislocations of this joint, in which excision of the projecting articular extremity has relieved the deformity and left a very useful member. The incisions for operations in contiguity should be made upon the latero-dorsal aspect, and, as far as possible, the attachments of the tendons should be respected.

Excision of the Metacarpal Bones.—Either one of the metacarpal bones may be removed entire or in part, without amputation of the corresponding finger, and the value of the finger in a great measure be retained. In the case of the thumb or index-finger, the incision should be made upon the radio-dorsal margin; but in the case of the little finger, upon the ulno-dorsal margin. In operations upon the metacarpal bones of the second and third fingers, the incisions may be made upon any part of the dorsal surface, but the tendons must be carefully avoided.

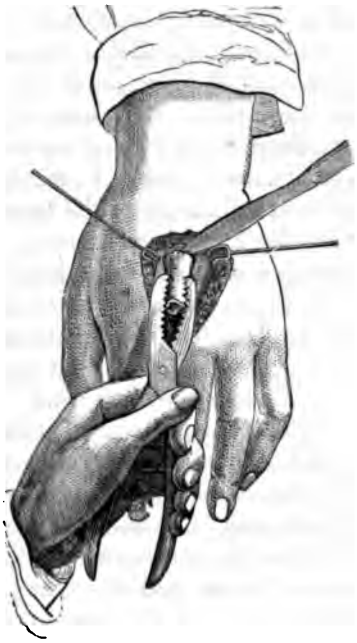
When an entire metacarpal bone is to be removed, it must first be divided in its shaft by the chain-saw or bone-cutter. It is often found difficult, when excision is to be practised upon the metacarpal bones pertaining to the second and third fingers, to introduce the chain-saw, and in this case, especially, the bone-cutter will have the preference. Whenever it is possible to do so, the distal extremity articulating with the corresponding phalanx should be preserved.

Fig. 175.



Section of Second Metacarpal Bone, with Bone-cutter.

Fig. 176.



Disarticulation after Section of the Bone.

Excision of the Carpal Bones.—In cases of caries, and also in recent gunshot injuries, I have often removed one or more of these bones with excellent results; but it is doubtful whether it is ever worth while to attempt to remove the whole or a large portion of them. I have done so in one instance; but the operation was exceedingly difficult, more or less of the tendons had to be cut, and eventually amputation became necessary. In case of the operation being undertaken, the bones should be approached from the dorsal surface, and the tendons, especially those attached to the thumb, should be respected as far as possible. The relations, also, of the radial and ulnar arteries to the carpus, on the outer and inner margins of the palmar aspect of the wrist, must not be forgotten. Mr. Lister, of Edinburgh, has made the operation fifteen times, and has given very minute directions as to the mode of procedure; but my conviction remains so strong that the operation is inexpedient, I shall omit to reproduce them.

Excision of the Radius and Ulna.—Both the radius and ulna, when necrosed, have been removed singly, and useful arms have been preserved. In some cases where care has been taken to preserve the periosteum, or where an involucrum had already in part formed prior to the operation, a considerable reproduction of bone has ensued. In making an operation of this kind, the brachial artery should be compressed by an assistant; and the incision should extend the whole length of the radio-dorsal or ulno-dorsal margins of the forearm. Disarticulation will be greatly facilitated by first dividing the bone through its shaft with the saw or bone-cutter.

Excision of a portion of the shaft of one or the other of these bones, for necrosis or other diseases, is often required; but in the case of a comminuted fracture of one bone of the forearm from any cause whatever, it must be borne in mind that excision of even a small portion of the entire diameter of the bone is pretty certain to result in non-union. It will be far better, therefore, to allow the fragments to remain, and to thus offer a chance for a deformed union, than to take the risk of no union at all. I have observed, also, that when a portion of the ulna is lost, and no bony union takes place, the head of the radius is very liable eventually to become displaced; or, if it is a portion of the radius which is lost, the lower end of the ulna sooner or later is thrust inwards and downwards. When both bones are broken, and the forearm is allowed to shorten upon itself, the danger of non-union is much less, and fragments may be removed more freely.

Excision at the Radio-carpal Articulation—Wrist-joint.—Excisions of the lower end of the radius alone, when not accompanied with a fracture and shortening of the ulna, invariably result in more or less deflection of the hand to the radial side. I have seen it turned in this direction to nearly a right angle. If, therefore, excision of the lower end of the radius is practised, and the ulna is not broken and overlapped, it will be advisable to remove at the same time an equal portion of the lower end of the ulna. In the single case in which I have adopted this practice, the subsequent inflammation and suppuration were moderate, the hand was restored, occupying its normal position, with good motion at the wrist-joint, and a useful amount of motion in the fingers. The great value of a thorough excision of both bones in this class of cases, as a means of insuring complete relaxation of the muscles, and of preventing subsequent inflammation, will be found fully explained and illustrated by cases in my treatise on Fractures and Dislocations, in the chapter entitled "Compound Dislocations of the Long Bones."

Excision at the Ulno-humeral Articulation—Elbow-joint.—Excision of the elbow-joint may be required in compound comminuted fractures involving the joint, and especially when caused by bullets; in compound dislocations; in chronic ulceration, caries and necrosis, or for the relief of bony anchylosis.

The operation is, in most cases, sufficiently simple and easy of execution, and may be practised by any surgeon competent to make an amputation. It does not necessarily involve the destruction of a single important blood-vessel or nerve, and in some instances the attachments of very few muscles are lost. In the case of fractures, where the bones are only slightly broken, although the joint may be freely laid open, a useful limb is often obtained by rest, and a judicious employment of splints. If the comminution is extensive, and at the same time the brachial artery is wounded, or both the median and ulnar nerves are torn, amputation is the only proper resort; but if, while extensive comminution exists, there is no injury to this artery, or to more than one of the principal nerves, then excision must be preferred. Excision made for recent fractures is in general more difficult, and demands, for the complete removal of the fragments, more free incisions than excision made for the removal of necrosed or carious bone; for the reason that the periosteum, with the ligaments, retain their natural attachments to the bone, and are sometimes with difficulty separated. In such cases, therefore, I have preferred the H-shaped incision, inasmuch as this form gives a more free access to the joint than any other which has been suggested. The mode of procedure will be as follows:—

Upon the dorsal aspect of the limb an incision is made along the radial margin, extending from a point one inch and a half above the articulation to about the same distance below; upon the ulnar margin, but to the radial side of the ulnar nerve as it passes behind the inner condyle, a similar incision is made of equal extent; the two are then united by a transverse incision over the centre of the olecranon process. The two quadrilateral flaps are now dissected up, the triceps severed from its attachment to the olecranon, and the joint more completely exposed by bending the arm to a right angle. In the subsequent steps of the operation the surgeon will be governed by the circumstances of the case, only that he will bear in mind two important principles, namely—not to wound or injure the ulnar nerve, and to exsect as little of the bones as possible. In some cases the ulnar nerve is already torn, or severely injured; if completely divided by the original injury, of course no attention need be paid to it; but if it has been exposed and lacerated it will be better to divide it at once with the knife. I have seen the omission to do this entail great suffering, and eventually permanent contraction of the hand and fingers. In most cases, however, this nerve has suffered no previous harm, and then great care must be taken to keep the knife close to the bone, and lift it from its situation without inflicting upon it any injury. Ordinarily it lies so embedded in the surrounding tissues that this will be accomplished without bringing it into view. In case it is found necessary to remove the lower end of the humerus above the condyles, it will be most convenient to employ the chain-saw; but ablation to this extent is apt to leave the elbow loose and preternaturally flexible, and if possible the excision should be more limited; we shall then accomplish our purpose best by dividing first the lateral ligaments, and, after exposing the lower

Of 626 cases of resections of the elbow-joint returned to the Surgeon-General's office from the late war, 470 recovered, 146 died, and in 10 the results are unknown. This gives a mortality of 23.7, which is slightly greater than the mean mortality after amputation of the upper arm as practised during the war. So far as could be ascertained, the mortality in 322 primary cases was 21.3; in 197 intermediary cases, 35.2; and in 54 secondary cases, 9.2. In a considerable number of these cases the excisions were partial.

Many of these cases were successful only in the sense that life was saved. Of the primary cases, 27 had to submit subsequently to amputation, others have suffered from neuralgia, paralysis, muscular atrophy caries and necrosis. In 83 cases there resulted complete anchylosis, and partial in 17. At least 13 have died from causes traceable to the mutilation.

Of the intermediary cases, 62, or nearly-one-half of the recovered cases, have complete anchylosis.

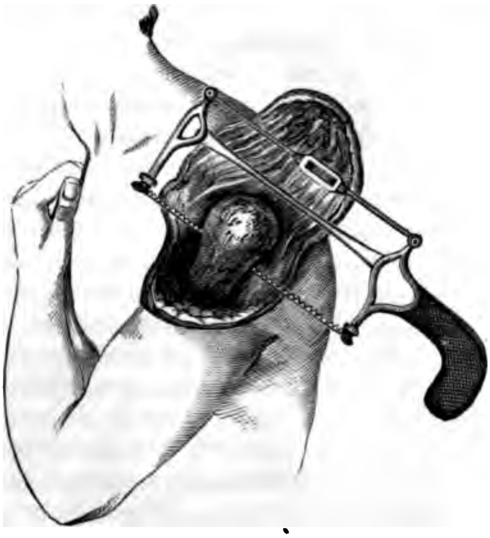
In the case of the secondary operation, of the 49 who recovered, 2 subsequently submitted to amputation, and 2 were subjected to operations for necrosis. In some cases neuralgia and paralysis ensued, and in most cases the motions of the joints were limited.

A comparison of the results of the operations, drawn from the United States Army records, is therefore unfavorable to excisions at this point in gunshot injuries. This result is opposed to the experience of the Crimean and Schleswig-Holstein wars. In my own experience, and in the experience of most surgeons, the operation has proved more successful; and in very many cases, especially when the operation has been made for chronic disease of the joints, the patients have retained almost complete use of the hand and arm.

Excision of the Humerus in Continuity.—A few fortunate examples in which excision of considerable portions of the shaft of the humerus have resulted in bony union, do not authorize a well-grounded hope that it will generally occur, or a repetition of the practice, except as a last alternative. The humerus is, of all bones in the body, that which most often refuses to unite after simple fracture; but when, in a case of comminuted and compound fracture, any considerable portion, or even a very small portion of the shaft is removed, the danger of non-union is greatly increased. It is better, therefore, as a rule, that the fragments should remain and the limb be permitted to unite with deformity, rather than that the risks of non-union should be incurred. In case, however, it is believed to be necessary to excise some portion, or to remove fragments which comprise the whole thickness of the shaft, the ends ought to be brought into contact by wire sutures, and perfect quietude subsequently maintained with carefully constructed splints of gutta-percha, made of sufficient length to extend from the shoulder to the hand.

arms supported by right-angled splints, the dressings loose, and saturated with pus. It is much better, in field practice, and quite as well in hospital and private practice, to close these wounds with adhesive plasters, or simple dressings, and leave them in all other respects unsupported and uncovered, only sustaining the arm in a sling. I wish to add, also, that rather than to crowd the lower fragment upwards toward the shoulder, it is better for the first week or two to allow it to fall easily downwards; and for this reason the sling should pass under the wrist, and not under the elbow-joint. If the elbow is much lifted, the upper end of the bone is liable to be tilted and thrust against, or through the flesh. At a later day, however, it becomes very important to lift the exsected bone toward the socket, in order to insure a short ligamentous union between the glenoid cavity and the humerus.

Fig. 179.

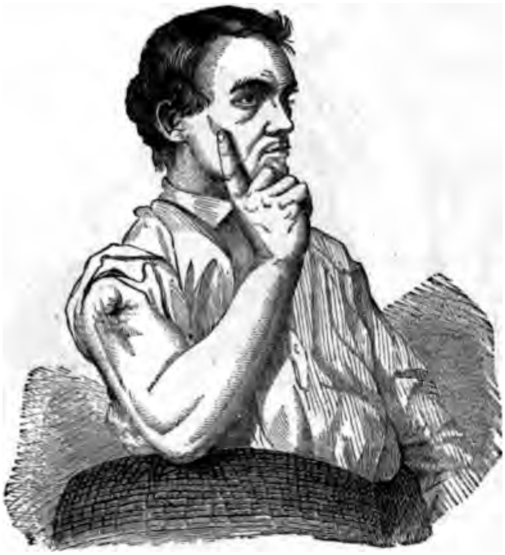


Excision of the Head of the Humerus by the Oval Method.

In a case of compound dislocation of the head of the humerus, an accident which is exceedingly rare, but of which I have witnessed one example into the axilla, it would, in my opinion, greatly increase the chances of recovery, if, before reduction, the head and a portion of the neck of the humerus were excised. By this procedure we should relax the muscles of the arm and remove one of the most active causes of inflammation.

Results of Excision of the Head of the Humerus.—It is in the shoulder and elbow joints that excision has achieved its greatest triumphs. In many cases where I have removed only the head of the humerus, with a small portion of the neck, the arm has been nearly or quite as useful as it was before. If the excision extends below the insertion of the pectoralis major and latissimus dorsi, some artificial support is usually required to give firmness and to restore the natural functions of the limb. Exceptions no doubt may be found, and on[illegible] example is cited in Circular No. 6, in which, after a removal of the upper third, a very useful limb was obtained; but such exceptions, according to my experience, are rare, and surgeons must not draw from these exceptional cases a conclusion that, the head and neck of the humerus being shattered, it is a matter of little consequence whether they divide the bone an inch or more lower down. It is quite probable, however, that in case three or four inches of the shaft of the humerus, reaching upwards to the neck, had to be removed, it would be better to remove the head and neck also, inasmuch as non-union in the continuity, which is almost inevitable in case a large portion of the shaft is removed, is more certain to maim the limb, than is the total loss of bone between the point of section and the glenoid cavity. In this latter case, if the union is obtained fortunately by a pretty short ligament, the functions of the limb will be but little impaired.

Fig. 180.



Result after excision of one-third of the Upper End of the Humerus. Circular No. 6, 1865.

In a summary of 885 shoulder-joint excisions contained in the final report of the Surgeon-General it is stated that 571 recovered, 305 died and in 9 cases the result is not known. The aggregate mortality of the 876 determined cases was 34.8 per cent.

Excision of the Scapula.—Langenbeck was the first, in 1855, to remove the entire scapula without amputation of the arm. He removed also at the same time a portion of the clavicle. Mr. Syme repeated the operation in 1856. The total number of excisions of the entire scapula without amputation up to 1868, when Dr. Stephen Rogers of this city made his excellent resumé of the subject, was nine, including the operation made by himself.[1] In neither of these cases did death result as a consequence of the operation. In the January number of the *New York Medical Journal* for 1869, my own case of excision is added, making in all 10 cases. Dr. Rogers has also added 5 others in which almost the entire bone was removed.

In the case reported by myself to the New York Pathological Society, the operation was made in 1866 for necrosis resulting from a grape-shot injury received in 1862. The patient recovered with a very useful arm. Two months after the operation there was no observable reproduction of bone, although most of the periosteum had been carefully prescribed. He died in 1874.

Excisions of the Lower Extremities.

Excision of the Toes.—In general, amputation of the phalanges of the toes is to be preferred to excision. In some cases, however, of caries of the articulation, and of valgus hallux, excisions of the phalangeal articulation or of the metatarso-phalangeal articulation may be practised with advantage.

Excision of the Metatarsal Bones.—It is equally true of these bones as of the phalanges of the toes, that excision cannot often be practised advantageously. Most of the diseases or injuries demanding the removal of one or more of these bones, necessitate also the removal of the corresponding toe or toes. Whenever exceptions occur, the surgeon will adopt such a mode of procedure as the circumstances of the case may indicate.

Excision of the Tarsal Bones.—Excisions of these bones may become necessary on account of caries, necrosis, compound fractures, compound dislocations, and occasionally from other causes.

Necrosis of the larger tarsal bones is of rare occurrence; but caries is not unfrequent, especially in persons of strumous and tuberculous habits. The primary affection inducing caries may be in the bones themselves or in the articulations; but, wherever it originates, the articulations in the one case, and the bones in the other, are prone to become secondarily implicated. The tarsal bones most subject to caries are the calcaneum, astragalus, scaphoid, and cuboid. I have met with necrosis most often in the cuneiform bones, ensuing usually upon gunshot and other injuries of the lower portion of the foot, and as a consequence of the extension of inflammation with suppuration along their common synovial surfaces.

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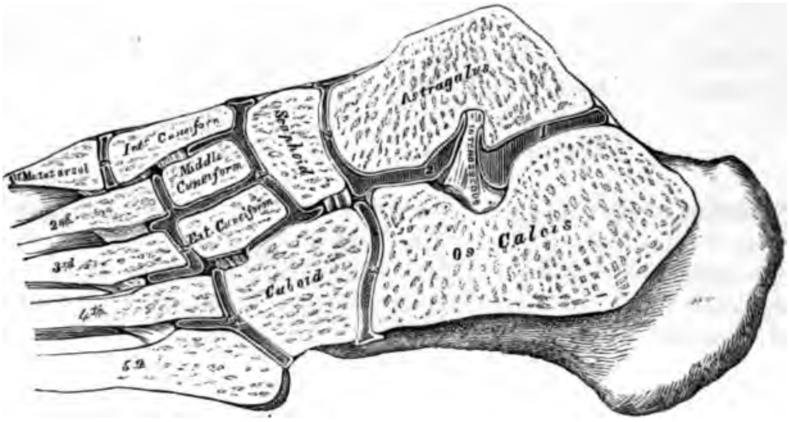
[1] Rogers. "Case of Excision of the entire Scapula, with a History of the Operations involving the Removal of all, or a considerable Part, of this Bone." *Amer. Journ. Med. Sci.*, Oct., 1868.

The anatomy of the synovial sacs of the tarsal articulations will explain the limitation of primary disease in the case of certain tarsal bones, and its tendency to extend in the case of certain other tarsal bones.

There are four distinct synovial sacs composing the tarsal articulations, namely: first, the posterior calcaneo-astragaloid; second, the anterior calcaneo-astragaloid, and the astragalo-scaphoid; third, the calcaneo-cuboid; and fourth, a synovial sac which is continuous between the scaphoid and three cuneiform, between the cuneiform individually, between the external cuneiform and the cuboid, and between the middle and external cuneiform on the one hand, and the corresponding metatarsal bones on the other. More or less, also, this latter cavity is prolonged between certain metatarsal bones.

Fig. 181.



Anatomy of Tarsal Synovial Sacs.

We shall observe, therefore, that disease of the first synovial sac is liable only to implicate the astragalus and calcaneum posteriorly; disease of the second may directly involve the anterior portions of the astragalus, calcaneum, and the scaphoid; disease of the third is likely to be limited to the calcaneum and cuboid; while disease of the fourth may rapidly and consecutively involve the cuneiform, cuboid, scaphoid, and even the metatarsal bones.

But primary disease of each individual bone is propagated chiefly to other bones through these synovial membranes; consequently disease of the calcaneum and of the astragalus is often limited to the bone in which it originated, while disease of either of the other bones extends, in most cases, to several or all of those with which its synovial sac is connected.

This statement, however, does not apply so rigorously to the astragalus as to the calcaneum, inasmuch as primary disease of the astragalus is much more liable to extend and involve other bones, than primary disease of the calcaneum—a fact which its anatomical connections, established through its synovial membranes, does not completely explain.

Caries of the calcaneum is often arrested by a careful removal of the carious and softened portions, without resort to complete exsection. For this purpose we employ the gouge; and the surgeon should bear in mind that it is better to remove a large portion, or, if it were possible, the whole of the interior of the bone, so as to leave nothing but a shell, rather than to exsect the entire bone, for the reasons that the calcaneum is essential to the support of the body, and when removed entire, important tendinous and aponeurotic attachments are disturbed. Moreover, the cavity created by removal of the interior is soon occupied by a firm cellulo-fibrous tissue, and possibly in some cases by bone, so that the utility of the limb is but little if at all impaired. The same remarks apply to caries of either of the other large tarsal bones; but the examples in which the disease is sufficiently limited to warrant the adoption of this method are, in the case of these bones, less frequent.

Before having resort to complete excision on account of caries of either of the tarsal bones, among other alternative expedients, it is especially proper to consider whether an arrest of the malady may not be accomplished by the seton. It is only a few months since that I was called some distance, for the purpose of amputating the foot, or of practising excision, in what seemed to be an incurable caries of several of the tarsal bones. An exploration made under the influence of ether encouraged me to hope that a favorable result might be obtained by the seton. Accordingly a large drainage tube was carried through the tarsus, from side to side, and at this moment the cure, with bony anchylosis, is complete. Similar examples are constantly coming under my notice. Oakum, first introduced into practice at Bellevue, answer the purpose of a seton, so far as drainage is concerned, quite as well as the drainage tube.

By one of these several alternatives, the seton, gouging, and excision, we are now able to save the limb in many cases where amputation was, not many years ago, too indiscriminately practised. This is properly deemed a great advance in conservative surgery; but there is some danger that in its application to this complicated series of articulations and easily disorganized bones, conservatism may be carried too far, or that the proper meaning and application of this term may be misunderstood. Conservatism does not consist in attempting to save a limb or a portion of a limb, at the risk of life. If, by this attempt, life is exposed to a single additional peril, conservatism demands that the limb should be sacrificed. I am certain that I have seen some lives lost by the injury or the delay caused by the seton, and by excision, in cases of tarsal caries, which might have been saved by amputation.

itself to this bone alone, or if only the head is involved, complete or partial excision is sometimes proper; the result being in some cases a very useful foot, with only a little shortening of the leg.

Incisions must be made upon the dorsal surface of the foot, and rather upon its outer aspect; the form and size of which will be determined by the circumstances of the case. As far as possible the tendons must be respected. The neck of the bone being exposed, is to be divided with the bone-cutter, and the disarticulation may now be effected by the aid of the knife and strong forceps.

Excision of the Scaphoid.—Primary disease of this bone, as of the astragalus, is exceedingly prone to become diffused, and it is seldom therefore that the malady is presented in a sufficiently stationary form to warrant exsection. The rules of procedure will, in such a case, be determined by the anatomy and relation of the structure involved. For the reasons which have been given, it will be advisable to substitute gouging, or even the seton, for complete excision, whenever it is practicable.

Excision of the Cuboid.—If a caries is limited to a portion only of this bone, as is rarely the case, it may be arrested perhaps by a judicious use of the gouge. In case complete excision is demanded it will sometimes be deemed advisable to remove also the little toe and its corresponding metatarsal bone.

Excision of the Cuneiform Bones.—I have seen no examples of caries of these bones which would justify excision; when necrosed, also, the adjacent bones are in most cases so much involved as to render amputation necessary, but occasionally I have removed necrosed fragments after gunshot and other comminuted fractures, from which good recoveries have ensued.

Excision of the Ankle-joint.—I have already, when speaking of excisions in general, alluded to the advantages derived from excision of the lower end of the tibia in certain compound dislocations of the ankle; and in my treatise on Fractures and Dislocations, in the chapter entitled, "Compound Dislocations of the Long Bones," the subject will be found very fully discussed. I have several times practised resection of the lower end of the tibia immediately after the occurrence of compound dislocations, and with the best results, both as regards the time required for recovery and the utility of the limb. By this practice the muscles are relieved of their tension, the foot placed at once in a natural position, and the ensuing inflammation is usually slight. I reserve the operation, however, for those cases in which the fibula is at the same time broken, and the tibia has been fairly thrust through the skin.

Excision at this articulation for chronic disease of the joint is seldom if ever advisable, since inflammation is prone to propagate itself downwards through the tarsal bones, leading eventually to the necessity of amputation, if it does not result in death.

The records of the late war furnish 33 cases of tibio-tarsal excisions. 22 survived the operation, and 9 died, giving a mortality of 29.0 per cent. In two cases the result was not ascertained. In four of the recovered cases amputation was subsequently made. Amputation would probably have given a better result.

Excision of the Shafts of the Tibia or Fibula.—Excision of portions of the shaft of the fibula is very seldom practised or required; nor does much importance attach to the removal of fragments of this bone, since it is not essential to the support of the body.

Excisions of portions of the tibia are, however, very frequently made. In cases of compound fracture of the tibia and fibula, the sharp spine of the tibia is very apt to protrude, and its reduction is sometimes not easily effected. In my opinion, however, it is generally better to secure its reduction by extension, aided by anæsthesia, or by incision of the integument, than to excise any considerable portion of the projecting point, since the latter practice is apt to be followed by delayed or non-union of the bone. Surgeons will have no difficulty in recognizing the exceptional examples which demand prompt resection.

Necrosis of the shaft of the tibia requires surgical interference whenever the dead bone is completely separated from the living. At an earlier period excision is useless if not mischievous. In the case of this bone it may be observed, also, that it is very common to find the necrosis extending throughout the entire shaft, but the epiphyses are seldom involved.

Excision of the Knee-joint.—Excision at this joint has been practised, chiefly for chronic ulcerative disease, involving the interarticular cartilages and epiphyses; for gunshot injuries of the joint, and for the relief of anchylosis.

The first point of inquiry, in any case where the relative advantages of excision or amputation may arise, ought always to be: by which method is life least endangered? I cannot understand how any surgeon can think differently. Have the advocates of this operation settled this question to their satisfaction? According to Hodges, 208 cases of excision, performed since the revival of the operation by Mr. Fergusson in 1850, present a mortality of nearly 29 per cent. Others, in their statistical statements, give somewhat more and others less favorable results; but I am certain from my own observation that even Hodges' reports, which have been made, no doubt, very carefully, give no adequate idea of the actual results. I believe that fully 50 per cent. have died, or have eventually demanded amputation. Of 431 cases collected by M. Pénières, amputation or resection was subsequently made in 71.[1] But accepting the most favorable statements of statisticians, as compared with amputations made at the knee-joint and in the lower third of the femur, for which alone excision is a substitute, the percentage of mortality is constantly less in the amputations than in the excisions.

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[1] *Archives générales de Méd.* Mai, 1870.

As a substitute for amputations in gunshot injury of the knee-joint excision has proven especially unfortunate. During the late war in this country, excision was practised for gunshot injuries of the knee-joint 57 times. Of these 44 died, 10 recovered, and 3 are undetermined, giving a mortality of 81.4. Prior to this war, according to Dr. Otis, there were 18 recorded examples of knee-joint resections for gunshot injuries, and of these 8 were successful, 9 fatal, and in one instance the result is not known.

As to the utility of the limb after a fortunate excision, it may be said: First, that while after excisions of joints connected with long bones, in all other cases we may hope to reconstruct a movable, fibrous, and sometimes a synovial articulation, in this case alone we dare not even make the attempt, since we should thereby greatly endanger the success of the operation, and perhaps the life of the patient; complete bony anchylosis is therefore almost inevitable. Second, the limb is more or less, and in most cases it is considerably, shortened by the operation. Third, in certain cases, especially in very young children, the growth of the limb is in some measure arrested by the removal of the epiphysis of the tibia, and the ultimate relative disproportion between the two limbs is greatly increased.

Operation.—Two parallel incisions of about six inches in length, having been made, one on each side of the knee, near the anterior margins of the lateral ligaments, the two are then united by a transverse incision, which crosses the front of the knee upon the lower margin of the patella. There are thus formed lines of incision representing the letter H, and two quadrilateral flaps. Next, the leg being bent to a right angle with the femur, the ligamentum patellæ, capsule, lateral ligaments, and crucial are successively divided.

An examination of the knee-joint should now be instituted in order to determine upon the form and amount of excision to be practised; the surgeon being governed in these points only by the character and extent of the lesions; he will, however, take care that the excisions of the femur and the leg are so made, as that when the surfaces are brought together, the limb will remain very slightly flexed at the knee-joint, a perfectly straight limb not being found so convenient for progression as one flexed to an angle of three or four degrees, which is indeed the usual position of the limb when we stand erect.

In dividing the bones a common saw may suffice, the soft parts on the sides and behind the bone being protected from injury by a strong piece of cotton cloth drawn closely around and behind the part to be removed.

As soon as the section is completed the surgeon will place the ends in contact, to ascertain whether the limb will occupy the proper position. If the angle at the knee is too great or too small, he will proceed at once to correct the error by the removal of another section.

In case only a small portion of one or both bones composing the joint has been removed, the patella may now be dissected out, the bones brought together and the incisions closed; but if a large portion of one or both bones has been excised, the knife will be again carried across the integument at the upper margin of the patella, so as to shorten the upper flap and at the same time remove the patella. Whatever method of operating is adopted, if the patella is in any degree involved in the disease it ought to be removed; experience having sufficiently shown that its presence, under these circumstances, generally protracts, and sometimes actually defeats, the cure.

Such of the arteries as have been wounded being tied, and the bones, being securely wired together at two or three points, the integuments may be closed with light and short adhesive strips, aided perhaps by a few wire or silk ligatures; and then the limb is laid in a long, well-fitted, and well-padded box or splint. The box may be made of zinc or tin, and supplied with floating sides opposite the knee, to enable the surgeon to dress the wound from time to time without disturbing the limb. A firm leather splint, or the immovable starch or plaster-of-Paris bandage, will answer very well, and are preferred by some surgeons.

J. Rhea Barton, of Philadelphia, first devised and executed the operation of excision for bony anchylosis of the knee-joint. The operation was made in May, 1835, upon a physician in whom the deformity had existed from childhood, the leg being fixed in a position somewhat less than a right angle with the thigh. The femur was exposed by incisions across the front of the thigh opposite the condyles, and a triangular piece of bone, not including its entire thickness, was removed with a narrow saw. By slightly bending the leg backwards the remaining portion of bone was broken, and the whole limb was now brought into line. Dr. Buck, of this city, modified the operation of Dr. Barton, by removing the triangular piece of bone at the knee-joint, so as to give a broader surface for support than could be furnished by Barton's operation; but the operation was attended with more difficulties and probably more risks; and as experience has proved that the additional breadth of support is not required, the operation of Barton has generally been preferred.

Excision of the Head and Neck of the Femur.—There are two leading conditions under which hip-joint excisions have been practised, namely: first, for the removal of carious or necrosed bone, resulting from chronic disease; and second, for the removal of shattered bone and of balls after gunshot fractures.

This operation was first performed for chronic disease of the joint by

Anthony White, of London, in April, 1822, since which time, and especially during the last twenty-five years, it has been made a great number of times, both in this country and abroad. The results, on the whole, have been satisfactory, although the reputation of the operation has been subjected to a severe trial on account of the inexperience of the operators, and the occasional lack of judgment in the selection of cases. Dr. Lyster, of Detroit, has collected 280 cases of this operation, including those collected by Ashurst, Good, and himself. The percentage of recoveries is as follows:—Under 5 years, 58 per cent.; 5 to 10 years, 68 per cent.; 10 to 15 years, 60 per cent.; 15 to 20 years, 38 per cent.; 20 to 30 years, 31 per cent.; over 30 years, 16 per cent.; not stated, 33 per cent. In regard to the utility of the limb, 103 proved useful, and 3 useless; not stated, 33; doubtful, 7.[1] Making all allowance for omissions and errors in the published records, the results would probably be found to be much more favorable than in the case of excisions of the knee-joint. Such at least is the conclusion to which my own observation and experience would lead me, without regard to the statistics, in which I confess I have not much confidence.

For the diagnosis and general treatment of hip-joint disease the reader is referred to the chapter on morbus coxæ. I propose in this place only to consider the special indications for excision, and the manner in which the operation is in general to be performed.

Acetabular arthritis of a chronic and suppurative character, resulting in caries or necrosis, may be regarded in general as incurable except by surgical interference. The fact that the acetabular portion of the pelvis is involved may be known by the formation of intra-pelvic abscesses, and sometimes by the displacement of the head of the femur through the perforated acetabulum and the consequent shortening of the limb, or by the crepitus occasioned whenever the limb is drawn down to its natural length. The implication of other portions of the pelvic bones will also be often easily recognized, by the formation of abscesses over the points affected, and by exploration with the probe through sinuses leading to the diseased bones.

Large portions of the pelvic bones are occasionally found necrosed, and in some cases carious, in consequence of disease originating in the joint, and they have been removed with successful results. Mr. Erichsen reports the case of a girl from whom he removed the upper end of the thigh bone, the acetabulum, the rami of the pubes and of the ischium, a portion of the tuber ischii, and a part of the dorsum ilii, who nevertheless recovered rapidly and with a very useful limb.

Femoral and Synovial Arthritis of a Chronic Character, ending in Caries, Necrosis, and Suppuration.—It is an undeniable fact that a considerable number of these cases get well spontaneously, or under judicious therapeutical and mechanical management. In the course of my life very many illustrations of the truth of this observation have come under my notice: a few of which have remained under my personal supervision until the cure has been effected; and many more have been seen only after the cure was completed, and when the patients, with shortened, anchylosed, atrophied, or distorted limbs, have become active and useful citizens.

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[1] Lyster, *Trans. Mich. Med. Soc.* 1870.

Nevertheless, my own experience has furnished me with a certain number of cases in which a portion or the whole of the head of the femur being necrosed, it has been impossible for nature to accomplish its extrusion; and in such cases the patients must either submit to a perpetual fistulous discharge, or, as more often happens, must eventually perish from the long-continued local irritation. I have in my possession a specimen illustrating necrosis of the head of the femur, which is so completely walled in by osteophytes that its escape was rendered impossible. In these examples it is certainly proper to open the joint and remove the imprisoned sequestrum, as I have myself had occasion to do in two instances, the operations being followed by speedy and complete recovery.

Caries of the head and neck of the femur, unattended by necrosis, a very common result of chronic inflammation invading the bony structures in this region, does not so imperatively demand incisions for its relief: first, because it is precisely in this class of cases that with improved hygiene, and absolute rest aided by extension, cures are often effected; and second, because excision of the diseased bone is not so certain to effect a cure as is the removal of the dead bone in cases of necrosis. But the restorative powers of the general system, aided by the means I have suggested, do not always accomplish a cure even in cases of caries; and there is a limit beyond which it is not prudent to tax the resources of nature. Here again the knife and the saw, or excision of the diseased bone, offers a resource well worthy of a trial.

Finally, there are many examples of acute and of subacute arthritis involving the hip-joint, constantly occurring, in which, under proper management, a complete and sometimes a speedy resolution occurs, leaving little or no traces of injury; and some in which, although suppuration does not take place, anchylosis results, as we might say, inevitably. The therapeutical consideration of these cases is referred to the chapter on Diseases of the Joints. They never demand excision.

Operation.—The following is the mode of procedure adopted and recommended by my colleague, Dr. Sayre. The patient resting upon his sound side, a knife is introduced at a point midway between the trochanter major and the anterior superior spinous process of the ilium and thrust boldly inwards until it reaches the acetabulum. From thence the incision is carried downwards, dividing the integument, muscles, and capsule, crossing the trochanter major a little back of its middle, and terminating, with a curve of the incision forwards, at point corresponding to the base and anterior margin of the trochanter major. By this method it is rendered certain that the incision will be sufficiently high to expose freely the head of the femur; the fibres of the gluteal muscle are separated longitudinally, and the incision, presenting a curve with its convexity backwards, a dependent wound is left for the free escape of the pus.

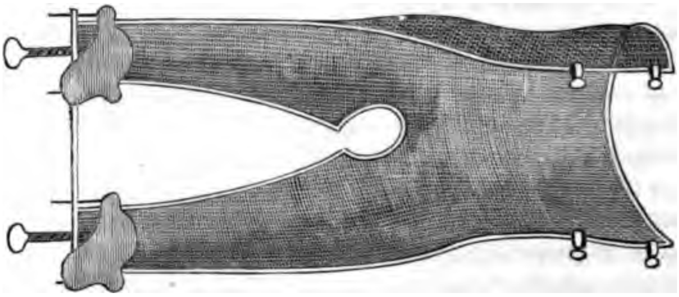
A knife is introduced at the lower angle of the wound and the periosteum divided at right angles with the shaft, over the outer semi-circumference of the bone, and at a point between the two trochanters; the periosteal elevator is then introduced, and the periosteum separated from the bone from this point upwards; the detachment of muscles in the trochanteric fossa being completed with the knife. The head and neck being released, the thigh is slightly adducted and the bone is divided with the chain or finger saw horizontally between the trochanters. The operation being completed, the wound is filled with oakum saturated with the balsam of Peru, and the patient is placed in Bauer's wire-breeches.

There are many examples, however, in which the precise form, position, and extent of the incision will be determined by the peculiarities of the individual case. In several of the cases in which I have operated, a sinus has furnished the most direct guide to the joint.

Whatever mode of procedure is adopted, the incisions should be bold and free, since there are no large arteries, veins, or nerves in the immediate vicinity of the parts to be exposed. The bleeding is, however, in most cases abundant, and in some profuse; but the source of this bleeding is, in a great measure, those spongy, vascular granulations which line the walls of the abscess, or the hyperæmic structures immediately surrounding the abscess, and it will cease in a few moments without the aid of ligatures. Division of the femur by the bone-cutter is attended with the danger of comminuting the lower or remaining moiety of bone, and for this reason the saw ought always to be preferred.

Philipeau, in his memoir on resection of the head of the femur, following Malgaigne, recommends that in all cases the trochanter major should be removed with the head and neck. This is rendered necessary in their opinion, because the trochanter is very liable itself to become carious subsequently, even when it appeared sound at the time of the operation, and because also it offers an obstacle to the free escape of pus. It is, however, equally important, according to my experience, to warn the surgeon against too extensive destruction of the shaft of the femur, and to remind him that in children the bone will often be found preternaturally soft and vascular below the point at which the section is made, and the medullary tissue vascular and disorganized to a certain extent; but that this condition does not imply the necessity of reapplying the saw at a lower point. Indeed, it is probable that in some of the cases which have come under my notice these pathological conditions, indicating subacute osteo-myelitis, have extended through the whole of the shaft. The prognosis is no doubt thereby rendered more grave, and one might seriously question whether it would not have been better for the patient if the operation had not been undertaken, or whether indeed amputation would not have given a better chance of recovery; but it will be useless to attempt to limit this condition by farther excision.

Fig. 183.



Bauer's Wire-splint.

Excision at the Hip-joint for Gunshot Injuries.—According to the report of the Surgeon-General, excision of the hip-joint for gun-shot injuries had been performed prior to the late war 16 times. Of these 2 were successful, although in one of the cases amputation subsequently became necessary. During the war 66 operations were performed, of which only 6 are reported as having recovered, a mortality of 90.9 per cent. Of 33 primary cases only 1 recovered. Of 22 intermediary, 2 recovered. Of 11 secondary operations, 3 recovered.

This is not a very encouraging amount of success, and yet, when compared with the results obtained in amputations at the hip-joint, it may be regarded as favorable. By a comparison of recorded facts, Dr Otis thinks he has established, also, that the mortality is less in excisions of the hip, than when the expectant plan has been pursued. I am not prepared to deny the correctness of his conclusions; but I see in the probable inaccuracy of diagnosis, in both classes of cases, many sources of error. Indeed, in my opinion, the surgeon is still justifiable in exercising a considerable amount of discretion as to the course to be pursued. If, for example, he has reasons to believe that the comminution is not extensive, and the patient is in a favorable condition as to health; if he is neither very fat nor very muscular; if the limb can be kept at rest, and moderate extension continuously applied, I believe an attempt may be properly made to save the limb without excision.

CHAPTER XX.

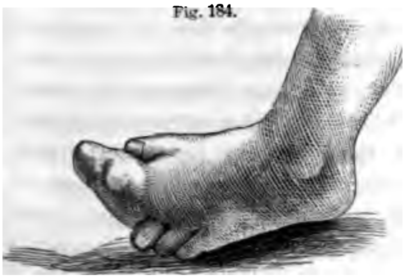
DISEASES OF THE BONES.

Section 1.—Errors of Nutrition.

Hypertrophy, or Enlargement and Growth of Bone. Syn., Hypertrophia Ossium, R. C.

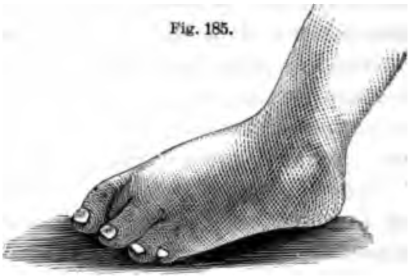
Examples of simple hypertrophy have been observed in nearly all the bones of the body. Sometimes it is presented as a congenital affection. I have removed a second toe from a child ten years of age which was four times its natural size, all the phalanges being greatly enlarged, and which condition had existed from birth. In one instance hypertrophy of the femur, with considerable lengthening, ensued upon a fracture through the lower epiphysis, but in which no displacement of the fragments ever occurred. Usually, hypertrophy of the tibia and fibula, or of other bones, has ensued upon some chronic affection of the adjacent soft parts, such as chronic eczema, or elephantiasis.

Fig. 184.



Congenital Hypertrophy of Second Toe.

Fig. 185.



Same after Amputation.

Treatment.—Whatever tends to diminish the vascularity of the affected parts may in some measure correct the faulty and excessive nutrition. The choice of measures for the accomplishment of this indication will depend upon the circumstances of the case, and must be left to the judgment of the surgeon.

Exostosis, or Circumscribed Hypertrophy will be considered in connection with tumors.

Atrophy of Bone. Syn., Atrophia Ossium, R. C.

Atrophy of bone may be caused by disease and consequent decay of nutrition, by a fracture and consequent lesion of the nutritious artery, and by various general or constitutional conditions, such for example as the conditions accompanying old age mollities ossium. and rachitis.

Bones in a condition of atrophy do not necessarily nor indeed generally diminish much in bulk, but they become lighter and more porous, the cortex being sometimes reduced to a thin shell, and the cancelli to a few fine threads, forming a reticulated tissue containing oil and fat globules.

The remedy for atrophy of the bones will be suggested when the cause is determined. In most cases it is irremediable.

SECTION 2.—RICKETS.

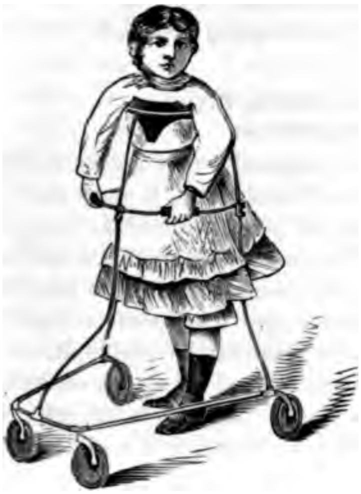
Syn., Rachitis, R. C.

Rickets is a disease of early life, and it is quite probable that the constitutional and predisposing causes are in most cases congenital, although its first manifestations are not usually observed until between the first and second years, and sometimes not until several years later It may be traced often to a hereditary strumous or syphilitic diathesis. Not very unfrequently, however, the rachitic child has presented during his early infancy an appearance of remarkable health and vigor; nevertheless, the bony distortions are almost invariably immediately preceded by symptoms which indicate a failure in health. The usual prodromes are disinclination to muscular exertion, inordinate and capricious appetite, an irregular state of the bowels, and a tumid or pot-belly.

The rachitic distortions are generally first observed in the lower epiphysis of the tibia and of the radius, and in the cranial bones. At length, however, nearly all the bones of the body become involved, including the vertebral column. In the case of the lower epiphysis of the radius and of the tibia, the deformity is chiefly due to expansion of their cartilaginous extremities, in consequence of which a remarkable depression exists just above the joint, and these children are called sometimes "double-jointed." A similar node-like expansion at the cartilaginous extremities of each of the ribs has been called the "rachitic garland." Either through muscular action, or in consequence of the pressure of the weight of the body, the entire shafts of the tibiæ and fibulæ eventually become bent, forming curves outwards and forwards; the femur and the long bones of the upper extremities may bend in a like manner, but in a less degree; the ribs become compressed laterally, causing the "pigeon-shaped" chest, or, as it is sometimes called, the *pectus carinatum;* the cranial bones develop unusually, although in some cases there is only a delay in development of the facial bones, in consequence of which the cranial bones are out of proportion; they also, sometimes, suffer a species of atrophy termed "cranio-tabes." The spinal distortion may be antero-posterior or lateral, or it may occur in both directions. When it is antero-posterior it is in most cases readily distinguished from caries by the extent and regularity of the curve.

Bones of rachitic patients also undergo other textural changes. The periosteum and medullary tissue exhibit increased vascularity; the medullary cavities enlarge at the expense of their lamellated walls, and become filled with a brownish red marrow; the sub-periosteal layer becomes infiltrated with an abundance of new cells embedded in a pinkish fluid, and subsequently new deposits of bony tissue in the same intercellular structures increase the circumference of the bone; the cartilaginous portions expand, especially as already stated, the cartilaginous epiphyses of the long bones; and finally, when the calcareous matter is redeposited, and both bones and cartilages have resumed their natural firmness, the patient remains permanently dwarfed and deformed.

Fig. 186.



Darrach's Wheel-crutch.

Although the pathological changes which take place in rachitis have been thoroughly studied, the immediate cause of these changes is undetermined. The statement made by most writers, that it is a condition of disturbed nutrition, affecting chiefly the bony system, is the simple announcement of a fact, but affords no satisfactory explanation of its cause. It has been suggested that the calcareous elements undergo solution from an excess of lactic acid; but the most popular and perhaps the most plausible theory at present entertained by pathologists is, that the disease is in some way allied to inflammation, in short that it is a variety of periostitis, ostitis, or osteo-myelitis. Although rachitis never terminates in suppuration, the doctrine of inflammation approaches more nearly to a solution of all the phenomena usually present than any other yet suggested.

Treatment.—Hygienic measures are of the first importance. Pure air, cool bathing, frictions and plenty of agreeable exercise, such as may be obtained by tumbling, rolling, and rollicking upon a hard mattress, or in some properly constructed wheel-crutch. The diet should be plain and nutritious, including such articles as meat, eggs, milk, and cod-liver oil. Bread, potatoes, and farinaceous food generally may be eaten, but not too freely. Vegetable and mineral tonics are sometimes useful. The phosphates and carbonates have been recommended upon chemical principles, but there is very little clinical evidence that they have ever aided in the restoration of the bones to their normal conditions. Dr. McCready's lacto-phosphates are probably more likely to be absorbed into the circulation than any other form of the phosphates, inasmuch as the salts are held in complete solution by the lactic acid.

Some light supports are occasionally employed with advantage to rectify the deformities of the legs; but they must not be so burdensome as to prevent the pretty free use of the limbs, and in examples of moderate curvature they had better be dispensed with altogether.

For the spinal distortions, also, light supporting apparatus, to be worn when the child is walking about, is sometimes useful; but such apparatus ought always to be regarded as wholly secondary in its relations to other means of treatment, and as liable to grave objections on account of the pressure which it must necessarily make upon the pelvic bones, and the embarrassment which it must cause to the free movements of the body. It is in the later stages of the affection only that spinal supports are generally found sufficiently useful to warrant their continuous employment.

SECTION 3.—MOLLITIES OSSIUM, R. C.

Syn., Osteomalacia; Malacosteon.

This disease occurs only in adults, and especially is it apt to be met with in women while in the puerperal condition. It is in most cases a general affection, but in some purely local, being limited to a single bone. As has been observed in rachitis, so also in mollities ossium, there is a deficiency of the earthy salts; but eventually in the progress of this latter malady the organic textures also disappear or become wholly changed in character; the medulla assumes the preponderance, and nothing may be left but a thin, flexible, cortical substance enclosing a fluid or semi-fluid, reddish, gelatinous mass. Rachitis is an error of development; but in osteomalacia there is an absorption and substitution of elements after the organization is completed. In proportion as the removal of both the earthy and organic elements is more complete in osteomalacia than in rachitis, the fragility of the bones is usually greater. Virchow regards the disease as a retrograde conversion of bone into medullary tissue.

Osteomalacia is almost constantly preceded by wandering pains resembling very much the pains which accompany muscular rheumatism, but much more severe and persistent in their character; the patient becomes feeble and emaciated; the bones yield to pressure and bend, or, as more often happens, break from the application of moderate force; the urine is often loaded with phosphates, and with animal matter in a condition of disorganization, and finally death ensues from exhaustion.

The treatment consists in the employment of nutrients and tonics No specific remedies have as yet been discovered.

SECTION 4.—INFLAMMATION OF THE PERIOSTEUM.

Syn., Periostitis, R. C.

Inflammation of the periosteum may be traumatic or idiopathic; primary or secondary; circumscribed or diffuse; simple or complicated it may be of a scrofulous, syphilitic, or rheumatic character.

Primary **Traumatic Periostitis** is generally reparative in its character, and terminates spontaneously in resolution, or the deep, osteogenetic layer of the periosteum suffers only that degree of excitation which is requisite to produce new bone or callus; but in a few exceptional cases the inflammation transcends these limits and causes a circumscribed subperiosteal abscess, which may be followed by eccentric laminated exfoliation of the bone.

There is, however, one form of acute periostitis nearly allied to traumatic periostitis, inasmuch as it is often provoked by external injuries, although it is in most cases remotely dependent upon a general dyscrasia, which is very prone to end in diffuse subperiosteal abscesses and eccentric necrosis. This variety may be termed **Acute Diffuse Periostitis.** It occurs most frequently about the period of puberty, especially in children of a strumous habit, more often in boys than in girls, and in the lower extremities more frequently than in the upper. The spine of the tibia is its favorite seat. When it attacks the femur the lower half or third of that bone is generally preferred.

The direct or exciting causes of acute diffuse periostitis have generally been observed to be external blows, eruptive fevers, long-continued exposure to cold and wet.

Symptoms of Periostitis.—Periostitis is not usually, at least during its early stages, attended by discoloration of the skin, but the pain is intense, deep-seated, and liable to nocturnal exacerbations; there is, in many cases, little or none of that puffiness which is always present in cellulitis; the swelling is limited to the neighborhood of the bone, and when suppuration takes place, fluctuation is in like manner limited.

Treatment.—The treatment of *primary*, acute, diffuse periostitis consists in absolute rest, in the application of cold lotions, or, in case this latter causes an increase of the pain, in the substitution of hot fomentations or warm poultices. Opiates may be given freely, or until the pain is in some measure subdued. When, in spite of these measures, the inflammation persists, free incisions ought to be practised, with a view of relieving the periosteal tension.

Traumatic periostitis, as the result of previous inflammation of the medulla or of the bone, properly called *secondary*, is much more grave than that form of the malady which has just been considered. In the primary form the constitutional disturbance is generally moderate, and the resulting necrosis, if necrosis occurs at all, is usually limited to the outer laminæ of the shaft of the bone; but in the secondary form, involving perhaps ostitis and medullitis, the constitutional disturbance is great, the whole shaft may become necrosed, and even the contiguous epiphyses and articular surfaces are often seriously implicated.

The treatment in these cases must be sustaining. Free incisions, with the application of the trephine, are sometimes proper surgical expedients; and in many cases amputation will eventually be required.

The specific forms of periostitis, dependent upon scrofulous, syphilitic, or rheumatic diatheses, cannot properly be considered in this connectio It may be remarked, however, that in all these forms the periosteu manifests but little tendency to the production of bone; suppuration comparatively unfrequent, especially in rheumatic periostitis, and each case the node-like swellings are remarkably amenable to app priate constitutional and local treatment.

SECTION 5.—INFLAMMATION OF THE BONE.

Syn., Ostitis, R. C.; Osteitis.

Ostitis, in the proper limitation of the term, is an inflammation of the bone-corpuscles and the calcified intercellular substance of the osseous tissue. Bone tissue is among the least vascular of all the tissues of the body, and but scantily supplied with corpuscular elements; consequently its liability to inflammation, as compared with other tissues, is inconsiderable. Ollier maintains that inflammation never affects primarily the bone-cells proper, but that its first invasions are always upon the marrow-cells, the inner or osteogenetic layer of the periosteum, and upon the contents of the Haversian canals. Ollier is probably correct, but it does not follow that we are to deny the existence of primary ostitis as distinguished from periostitis and medullitis. The facts in regard to the occurrence of ostitis may be stated as follows:—First, primary acute ostitis, and especially that which is of traumatic origin, is exceedingly rare, and in addition to the reasons which have been assigned for this infrequency, namely, the low vascularity of bone tissue and the paucity of its corpuscular elements, there may be added the negative consideration of the high vascularity and richness in cell structure of the medulla and the periosteum, in consequence of which these structures speedily inflame, so that an injury capable of causing inflammation of the bone tissue must almost necessarily be anticipated by inflammation of the medulla and periosteum, which, it is to be presumed, have suffered injury at the same moment, and generally in an equal degree: Second, primary chronic ostitis is more frequent than acute; inasmuch as it is more often dependent in some measure upon constitutional causes which, as is well known, are capable of determining specifically the location of morbid actions. This form of ostitis is, however, much less frequent than periostitis or medullitis: Third, primary ostitis, whether acute or chronic, generally induces, secondarily, periostitis and medullitis; but in a few examples the ostitis is exclusive, and limited during its progress and up to the period of its termination. Lidell has given an example of limited traumatic chronic ostitis,[1] and

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[1] *On the Wounds of the Blood-vessels, Secondary Traumatic Lesions of Bone, and Pyæmia.* By John A. Lidell, A.M., M.D., U. S. Sanitary Commission Memoirs, Surgical, vol. i. Published by Hurd & Houghton, Cambridge, 1870.

I have met with several examples in private practice: Fourth, secondary ostitis is not unfrequent; but in these examples the precedent medullitis or periostitis does not cease on the occurrence of ostitis, so that it must be more properly designated osteo-periosteo-medullitis.

Inflammation of the bone tissue, according to Lidell, causes, in most cases, first, an induration or an increase in its density, and at the same time minute red spots are observed in the substance and upon the exterior of the bone; subsequently, in the progress of the inflammation the bone becomes porous in consequence of the enlargement of the Haversian canals and of the stellate bone-cells; while at the same moment the intercellular bony structure, receiving additional calcareous deposits, becomes more dense and even eburnated. Usually, also, the entire diameter of the bone undergoes some enlargement, the increase in size being at the expense of both the periosteal and medullary surfaces. Sometimes it is also perceptibly increased in length. In short, then, bone suffering under an inflammation which does not cause strangulation and necrosis, or caries, but in which the action of inflammation may be regarded as reparative, causes induration, osteo-porosis, and hypertrophy.

In some cases the absorption or metamorphosis of the osseous elements composing the walls of the Haversian canals and of the bone-cells, with the intermediate osseous structure, lead to the formation of enormous canals and bone cysts; the latter usually containing medullized bone-tissue in a fluid state. Examples of ostitis are frequently met with in which the porosity is very general and pretty uniformly diffused, being much in excess of the induration, the bone being actually lighter, and presenting a worm-eaten appearance; while on the other hand the induration may be greatly in excess, the bone-cells and the Haversian canals being diminished in size or actually obliterated.

Inflammation of the bone may exceed the limits assigned to reparative action, or it may be retrogressive in its character, and the bone tissue, undergoing first a transformation into granulation tissue and then into pus, may cause the formation of an *abscess*. This process is essentially the same as that hereafter to be described, called caries.

Finally, ostitis may cause such a degree of obstruction in the nutrient channels as to cause necrosis, or death of the bone.

Symptoms of Inflammation of the Bone.—Ostitis is characterized by deep-seated, well-localized tensive pains, which are usually aggravated at night; by tenderness over the affected part, and, when it has continued some time, by the gradual, but not distinctly circumscribed enlargement of the bone. In this latter circumstance it differs essentially from periostitis. The constitutional symptoms are generally more intense than in cases of periostitis, and less intense than in cases of osteo-myelitis. Uncomplicated ostitis seldom causes death except by the supervention of pyæmia, an event which is much less apt to occur in connection with ostitis than with osteo-myelitis.

Treatment.—In acute ostitis blood-letting, cathartics, and diuretics are sometimes demanded. Rest and cooling lotions constitute the most important local measures.

In chronic ostitis iodine in some of its forms, given internally, may prove useful. As local applications, the tincture of iodine and vesicants are entitled to the most confidence. Deep periosteal incisions sometimes abate the severity of the pains in both varieties, but they are not alone competent to establish a cure.

When pus forms it should be freely evacuated by the aid of the trephine, and the pyogenic membrane lining the walls of the abscess should be destroyed. Long-continued localized inflammation of a bone, especially when seated in an epiphysis, and when attended with unremitting pain, warrants a suspicion that pus has formed, and justifies the application of the trephine; indeed, examples are not unfrequent in which the application of the trephine has given relief although no pus has been evacuated.

SECTION 6.—INFLAMMATION OF THE MEDULLARY TISSUE OF THE BONE.

Syn., Osteo-myelitis, R. C.; Endostitis; Medullitis.

Osteo-myelitis is the name usually applied by modern writers to inflammation of the medullary tissue of the bone. The term refers not to inflammation of the marrow and bone, but properly to the osteal marrow as distinguished from the spinal marrow. It is nevertheless true that osteo-myelitis seldom or never occurs without compromising the bone also in the inflammatory action.

Osteo-myelitis may be acute or chronic. Writers also speak of diffuse and circumscribed osteo-myelitis. Acute osteo-myelitis is in general diffuse and suppurative; while chronic osteo-myelitis is more often circumscribed, and is less prone to result in suppuration.

The causes of osteo-myelitis are general, or those which affect the general system, and local. Among the general or systemic causes may be enumerated as first, in point of importance, an unsound state of health. Persons who are of a strumous habit, or who possess a lymphatic temperament, those who are laboring under a syphilitic or cancerous cachexia, or whose blood is impoverished by innutritious diet, who have become drained by long-continued discharges of pus, or the vigor of whose systems have been impaired by excessive fatigue, by long marches, and by labor in the trenches, whose blood is vitiated by the impure air of hospitals, or of overcrowded rooms, are especially liable.

It is more common in males than in females; and children are especially and pre-eminently the subjects of osteo-myelitis.

A few rare examples have been recorded of what might be termed idiopathic osteo-myelitis, for the existence of which no local or constitutional cause could be assigned. It has been known also to supervene upon an idiopathic fever.

The local or special causes may in general be said to be traumatic, inasmuch as osteo-myelitis, when dependent upon a local cause, is almost invariably the result of some injury inflicted upon the bone, such, for example, as a simple contusion, a fracture, simple or compound, the application of the saw in amputation or in resection, etc. It may be caused, also, by the lodgment of a foreign body, such as a bullet or other substance in the medullary canal.

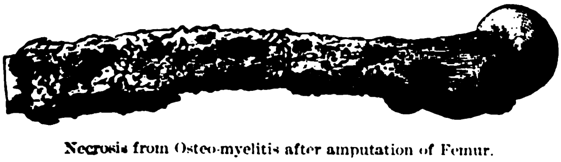
Symptoms of Osteo-myelitis.—According to Lidell, the pain in acute non-traumatic inflammation of the marrow precedes all other phenomena. It is intense and unremitting both night and day, and progressively increases in severity until relieved by the escape of pus. Generally the pain is well localized, but in some cases it is diffused. Chassaignac speaks of the pain, also, as peculiar, the patient almost always comparing it to the sensations caused by a fracture, so that whenever he is moved he cries out, "You are breaking my leg." There is generally a slight discoloration of the integument, and moderate elevation of superficial temperature, with marked tenderness upon pressure. One of the most characteristic symptoms, however, is the puffy or œdematous swelling, resembling somewhat the swelling of ordinary œdema, but which differs in this regard, that it terminates by an abrupt margin. This abrupt margin, it has also been ascertained, generally indicates the limits of the osteo-myelitis. Lidell speaks of it as having been especially observed in the non-traumatic varieties, but I have been able in this way to diagnosticate a case of chronic traumatic medullitis, and to define its exact limitations.

Chassaignac has made the observation, also, that the pus discharged from a deep abscess overlying osteo-myelitis contains an admixture of free oil. The same has been noticed, also, in sub-periosteal abscesses, but not in abscesses the result of simple cellulitis.

The traumatic fever accompanying acute osteo-myelitis is of an irritative character, and usually of a low type; the nervous system is early disturbed, and delirium is a frequent attendant.

When, after amputation, the exposed end of the bone becomes affected with medullitis, the patient complains of pain in the bone;

Fig. 187.



Necrosis from Osteo-myelitis after amputation of Femur.

the soft parts swell and sometimes appear puffy; the secretions are less healthy, being more thin and serous in quality and diminished in quantity; the flaps of the stump open and retract, and the medulla is seen swollen and protruding from the medullary canal, at first of a reddish or dark brown color, and subsequently dotted with suppurating points, or it sloughs and falls away in mass, giving out always a very fetid odor.

"Suppurative osteo-myelitis" is not a distinct form of inflammation of the medulla, but only represents a later stage in the progress of the disease. The medullary tissue, previously carnified by the inflammatory process, now undergoes a transformation into pus-corpuscles and liquor puris.

The principal pathological changes which take place in the medulla, the bone itself, and the parts adjacent, as a consequence of osteo-myelitis, may be briefly stated as follows:—Carnification or hepatization of the marrow, suppuration and gangrene of the same, central necrosis, and sometimes necrosis in totality; it may also lead to caries, osteoporosis, pyarthrosis, or suppuration within the adjacent articular capsules; extending beyond the limits of the bone primarily attacked, it may invade adjacent or contiguous bones, or several bones may be affected simultaneously; new bony growths, termed *endostoses*, may be developed within the medullary canal by direct transformation of the medullary into osseous tissue. The periosteum may, at the same time, be stimulated to undue osteogenesis, and new laminæ of bone be arranged upon the periphery; a phenomenon termed *periostosis*.

Lidell declares that in an analysis of fifty-one cases of osteo-myelitis observed by him, seven had thrombosis; and he is of opinion that the obstruction of the veins caused by thrombi is the occasion of that diffused bleeding of the granulations called *parenchymatous hæmorrhage*, which is sometimes observed in connection with osteo-myelitis.

Pyæmia may properly be considered as one of the natural sequences of osteo-myelitis, inasmuch as in a very large proportion of the cases which terminate fatally pyæmia is present. It is quite probable, however, that in an equally large proportion of the cases which terminate favorably it is never present. The relations of pyæmia to osteo-myelitis are rendered more obvious by the fact that pyæmia is almost unknown except in connection with suppurative inflammations of the bones.

The symptoms which denote the existence of pyæmia are chills, occurring with no marked regularity, followed by profuse perspiration, great and increasing prostration, nausea and vomiting, delirium, a bronzed or yellowish color of the skin, and a peculiar sweet, mawkish odor of the breath, compared sometimes to the odor of treacle. This latter symptom has sometimes been considered especially diagnostic; but I observe that it is sometimes absent in well-marked examples of pyæmia, and that it is occasionally present where pyæmia does not exist, but only a condition of extreme exhaustion from anæmia.

The specific causes and the precise pathological character of pyæmia are not yet fully determined. There is much probability, however, that it is a variety of septicæmia, and that it is induced by the reception into the system from the suppurating depots, of certain septic elements, or of elements which have undergone a gangrenous or possibly only a suppurative degeneration.

Dr. Woodward, by a series of careful observations, has shown that diffuse gangrene of the marrow is a very common coincident with pyæmia; and from this fact, in connection with others, he infers that, at least, in an important and frequent group of cases the putrefactive changes going on in the marrow are communicated through the coagulated blood of the veins, not by absorption but by direct continuity.

Lidell prefers to consider pyæmia as a species of septicæmia, or blood-poisoning, clinically distinct from septicæmia arising from dissection wounds, senile gangrene, hospital gangrene, etc., but to be arranged under the same genus. The remarkable absorbent powers of the marrow was shown by the experiments of Ollier; and to account for the frequency of this variety of septicæmia in connection with osteo-myelitis, we have only to recall the readiness with which the marrow takes on the suppurative action, its liability to farther degenerative changes, and the remarkable absorbent activity of the interior of the bone; but in order to explain the peculiar phenomena which this species of septic intoxication presents, we must assume, also, that the septic materials generated by suppurating, or gangrenous marrow are also peculiar, and in some sense specific.

Treatment of Osteo-myelitis.—The experience of army surgeons has sufficiently shown that among the most fruitful sources of osteo-myelitis and pyæmia must be enumerated imperfect hygiene. Improved hygiene constitutes, therefore, an essential part of the treatment. The patient must be removed from infected air; and in the field this is in no way so well accomplished as by removal to a tent. In private houses the windows should, at most seasons of the year, be kept constantly open; the dressings should be taken away often, and the wound thoroughly disinfected with carbolic acid solutions or with the chlorides; the diet should be nutritious. Tonics are generally demanded, and stimulants may be employed at the discretion of the surgeon. Of the tonics, I have found quinine the most useful, given in doses of about two grains every four or six hours.

When pyæmic symptoms supervene, quinine may be given with advantage in much larger doses. I have recently seen a case of pyæmia supervening upon an injury of the skull, brought to a successful issue by fifteen-grain doses of quinine given every six hours for a period of two days.

As topical applications in some of the most acute forms of the malady, ice has proved very efficient. For this purpose we have employed of late, at the Bellevue Hospital, small India-rubber bags furnished with stop-cocks. If the application of ice causes pain, or rigors, it must be discontinued, and hot-water or water of a temperature more agreeable to the patient must be substituted.

Free incisions, made with the view of relieving the tension of the periosteum and of the more superficial tissues, is sometimes practised with advantage; but such incisions are always liable to the objection of increasing the extent of the suppurating surface, and must be resorted to only in rare and exceptional cases.

If the interior of the bone is not already laid open, and we have reasons to suspect the imprisonment of pus or of gangrenous materials, the trephine should be promptly applied.

Excision offers no resource in acute osteo-myelitis; but amputation is occasionally successful, and even when made after the supervention of pyæmia, a certain number of recoveries have been reported. As a rule, however, amputation at this period only precipitates the fatal event; and we cannot, therefore, urge its performance except in the earlier periods of the progress of the malady. At any period of time amputation must be regarded as an uncertain and doubtful remedy. If this measure is decided upon, the section of the bone must be made fairly above the point of inflammatory lesion; and in the case of acute diffuse osteo-myelitis this condition can only be fulfilled by amputating at or above the nearest articulation in the direction toward the body.

Chronic, or subacute osteo-myelitis demands such modifications of treatment as are found necessary in similar grades of inflammation occurring in the soft parts. The iodide of potassium given internally, and the tincture of iodine applied externally, have been found serviceable. When a circumscribed abscess forms, as most frequently happens in the epiphyses of the long bones, and especially in the lower end of the tibia, it must be evacuated by the trephine.

Both amputation and excision may be considered valuable surgical expedients in the chronic and more circumscribed forms of osteo-myelitis.

The rule in regard to the point of amputation which has been established for acute, and acute diffuse osteo-myelitis, namely, that we must not amputate in the continuity of the affected bone, does not apply so rigidly to chronic, and chronic circumscribed osteo-myelitis. Two examples have recently occurred in my own practice which confirm the propriety of these exceptions.

Caries.

Caries, like sclerosis or consolidation of bone-tissue, is a result of ostitis; but in the case of caries the inflammatory action is degenerative, and in the case of sclerosis it is reparative or formative. Caries is most commonly observed in the small and spongy bones, and next in point of frequency in the epiphyses of the long bones. It is seldom seen in the diaphyses or in the lamellated structure of the long bones. The exceptional examples have been observed by me most frequently in the upper third of the shaft of the tibia.

When ostitis causes caries, the porosity increases under the inflammatory action, and the bone structure becomes soft, so that it can be readily cut with the knife. Sclerosis often attends caries, but it is limited to the outer margin or periphery of the inflamed structure, and in this direction there are frequently observed upon the surface nodular deposits of bone, but these are usually derived chiefly from the osteogenetic layers of the periosteum. As the degenerative inflammatory action progresses, the bone-tissue changes its structure, becoming converted into granulation tissue, or the bone-corpuscles may perish, leaving a fatty residuum. The granulation tissue, when formed, may continue to proliferate so that it presses out in every direction wherever a tegumentary outlet permits its escape; or, the retrograde action continuing, it may be converted into pus.

Occasionally the degenerative action is unusually rapid, and the ostein or animal matter being destroyed before the bone-corpuscles have undergone the granulation metamorphosis, minute bony masses, become separated and hang by the granulations or fall away with the pus, giving to the secretions a gritty feel. This condition has been called **Caries Necrotica.**

Treatment.—In the specific forms of caries, such as the scrofulous, and syphilitic, constitutional remedies are of the first importance. The same is true, also, of many cases of caries which are not specific, but in which the general system is affected with a dyscrasia, or the powers of repair are greatly weakened.

The local remedies are:—First, excision of the carious and softened bone by the gouge, the chisel, the knife, or the saw. Where the ostitis is well localized, and limited to a small portion of the bone, especially when its existence is in no way dependent upon a constitutional dyscrasia, this method is often successful; but when these measures are adopted, one absolute condition of success is, that all of the inflamed and softened tissue shall be removed. When joints are involved, excision or amputation has to be practised. Second, the destruction of the carious and inflamed bone by actual cautery. This method was practised very much by the older surgeons; but, probably without sufficient reason, it has of late gone into disuse. Third, solution of the softened and disintegrating bone by the mineral and vegetable acids. For this purpose I have seen solutions of nitric and sulphuric acids used with excellent results. Of late citric acid has been recommended; and, as lactic acid is one of the best solvents of the phosphates which we possess, I presume that equally good results might be obtained from its use also.

Necrosis.

Necrosis, or the death of bone, is almost invariably a result of inflammation. Lidell relates some cases, however, in which the death was caused immediately by the concussive effects of gunshot projectiles. Ordinarily, the simple removal of a limited portion of the periosteum or of the medullary tissue does not cause necrosis.

M. Gerdy denies that inflammation of the bone ever causes necrosis. Primary and exclusive ostitis is probably an unfrequent cause of necrosis; but secondary ostitis, or ostitis consecutive upon periostitis and medullitis, is thought by Lidell to be the most constant cause of necrosis. He states, moreover, that in his opinion when osteo-myelitis or periostitis occasions necrosis, it does so chiefly by inducing ostitis.

Primarily, inflammation of the marrow tissue is the most frequent cause of necrosis, because first, the marrow tissue is eminently liable to inflammation; and second, because the bone tissue receives its principal supply of blood from the medullary tissue; but this supply is distributed mainly to the inner laminæ of the bone, consequently death of the bone from medullitis is usually concentric or central.

Inflammation of the periosteum is the second most important cause of necrosis. The periosteum, however, furnishes a more limited supply of blood than the medullary tissue, and its vessels penetrate less deeply; consequently the necrosis caused by periostitis is eccentric or peripheral, and limited. The sequestrum is usually presented in the form of thin scales or laminæ.

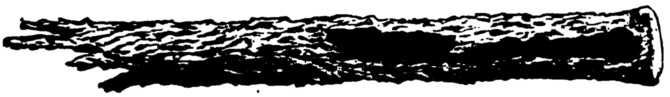
Inflammation of the bone itself, that is, ostitis, whether it be primary or secondary, whether limited to the bone or involving also the periosteum and medulla, causes death in totality, or throughout the entire thickness of the shaft.

Inflammation causes death in bone by strangulation, or by the interruption which it occasions to vascular supply; necrosis resembling in this regard gangrene of the soft parts caused by inflammation. Like gangrene, also, it may be dry or moist; but while in the case of the soft parts dry gangrene is the exception and moist gangrene the rule, the reverse is true of necrosis. The large majority of examples of necrosis correspond to that condition in the soft parts which we term dry gangrene; the bone is deprived of blood, and it is consequently, unless exposed to the air, dry, hard, white, or yellowish-white in color, sonorous when struck, and, as compared with moist necrosis, it is inodorous.

Lidell has particularly described the *moist* or *mephitic* variety of necrosis, which he has never seen occur except in connection with pyæmia. The dead bone is, under these circumstances, "moist, more or less softened in consistence, of a dirty gray, dirty pale-green, or dirty greenish-brown color, and it exhales the intolerably offensive odor of rotting bone."

Spontaneous necrosis of the long bones occurs most frequently be- een the eighth and twentieth years of life, and more frequently in

Fig. 188.



Necrosis in totality after Amputation of Femur. 9⅛ inches in length.

les than in females; while advancing age appears to favor the occur- ce of caries. The bones most liable to necrosis are the tibia, femur, humerus. The tibia is generally attacked by superficial necrosis ig the spine, and by concentric necrosis through the central portions he shaft. In the femur it is the lower third which is usually cted, and in the humerus the upper third.

ecrosis of the shaft of a long bone seldom extends beyond the point unction of the epiphysis with the diaphysis.

nnular necrosis often ensues upon amputations, in consequence he injury done to the bone and to the medullary tissue by the ac- of the saw, especially when the section is made through the com- cancellous structure of the shafts of the long bones.

rocess of Separation and Exfoliation of the Dead Bone, or uestrum.—A sequestrum is a portion of bone separated from the n body, but, as Ollier has correctly stated, not necessarily entirely l or completely detached. The separation is completed when noth- but granulation tissue remains between the bony fragments; but shall often observe that this interposed granulation tissue is firmly erent not only to the main fragment, but also to the sequestrum by a ongation of the granulations into the numerous small and irregular ressions which exist upon its surface. If we forcibly separate the estrum from its bed of granulations, it will be followed by a copious orrhage. This I have particularly observed after the removal of e superficial necroses of the skull. A more careful inspection of sequestrum will now demonstrate that the vessels of the granula- s were prolonged into the substance of the sequestrum, penetrating every direction, and that consequently it had not ceased to live: ed it is evident that in consequence of this remaining circulation vitality, it was gradually being reduced in weight and size by a metamorphosis, the bone tissue undergoing a change into granula- tissue and into pus. Dead bone, or bone completely exfoliated, ergoes no such changes. The separation and final exfoliation of sequestrum is therefore effected by a vital but degenerative process ch commences usually upon the surface, forming, at first, a superfi- furrow filled with granulations: this furrow deepens into a chasm, finally the sequestrum is at every point separated from the main before complete and spontaneous separation has taken place is almost inevitably followed by additional necrosis.

The process of separation is slower when necrosis affects the lamellated tissue of the long bones than when it affects the epiphyses. It is slower also in adults than in children, in the lower extremities than in the upper. In the bones of the face it is especially rapid. I have observed, also, that syphilitic necrosis is remarkably tardy in the process of separation. It will not alter the practice, however, that the separation is delayed. We have only to wait patiently, sustaining the patient by appropriate treatment as well as we can, until the process is accomplished.

In case the sequestrum, after separation, is found to be imprisoned by an involucrum, its removal must be effected by the trephine, or with the trephine aided by the chisel and mallet. It may be well to remind the young surgeon again that the separation of a sequestrum is often completed long before it can be made to move under the probe, its immobility being due to the manner in which it is embraced by the involucrum. In such cases we must decide upon the probabilities of separation by the length of time which has elapsed since the commencement of the malady.

There is one more point upon which the surgeon needs to be warned. The periosteum covering an involucrum is always thickened, and its attachment to the involucrum is so feeble that it is with great ease torn up by the fingers. I have seen the entire shaft of a bone thus removed, presenting an involucrum enclosing a separated sequestrum. It is unnecessary to say that such a procedure was unjustifiable.

CHAPTER XXI.

DISEASES OF THE JOINTS.

SECTION 1.—SYNOVITIS.

Syn., Inflammatio Synovialis, R. C.

SYNOVIAL membranes are not in a strict anatomical sense serous structures, but they occupy an intermediate position between the serous and mucous. We observe, likewise, that their pathological lesions correspond in some measure to these anatomical peculiarities. Inflammations of synovial surfaces, when occurring in healthy constitutions, are in general less acute and less disposed to plastic effusions than inflammations of serous surfaces; while, on the other hand, they are in plastic effusions, and when the serous surfaces and the cartilages of incrustation have yielded to the destructive processes of the inflammation, fibrous bands bind the adjacent surfaces, causing more or less complete **false anchylosis**; or the opposing articular surfaces become united by bone, constituting **true or complete bony anchylosis.**

The symptoms of acute synovitis are pain, swelling, heat, and tenderness. The pain is generally severe, and in most cases it is limited to parts in the neighborhood of the structures affected. In the case of the hip-joint, and occasionally when other joints are inflamed, reflex pains are often experienced, in parts remote from the actual seat of disease, and most commonly in those nervous filaments supplying muscles which move the affected joints. Reflex pains are usually more severe at night, and they are frequently accompanied with muscular spasms. When the knee is the seat of synovitis, the joint appears most swollen above the patella, where the synovial sac reaches upwards beneath the tendon of the quadriceps, and on either side of the patella. The fluid can be observed to fluctuate or undulate from side to side, when pressure is made. The leg is generally flexed upon the thigh; a position assumed partly because it alleviates the pain, and partly because the flexor muscles are usually in the greatest tension, and compel the limb to assume this position.

In chronic synovitis there is usually no discoloration, and the pain is a much less prominent symptom; yet neither pain nor tenderness is often wholly absent. In a few examples, especially where chronic synovitis occurs in broken and irritable constitutions, the tenderness is excessive, and motion causes the most acute pain. The swelling, however, caused by the intra-capsular effusions is a marked and diagnostic symptom.

Treatment of Synovitis.—Acute synovitis, like other forms of acute inflammation, demands, first of all, absolute rest; and where this cannot be otherwise secured, it must be accomplished by the aid of well-adjusted splints. The second consideration is position; not with reference to the future usefulness of the limb in case anchylosis were to ensue, but now solely with reference to the influence of position in relieving inflammation of the synovial surfaces. In the case of the lower extremities, experience has shown that when the hip-joint is inflamed it is put in the most favorable position for repair when the axis of the thigh corresponds with the axis of the body; and that, also, when the knee-joint is in like manner affected, the inflammation and pain are abated when the limb is straight. If an explanation of these facts were asked, it might be difficult to furnish a wholly satisfactory answer; but it is possible that it may be found in the less sensibility or greater capacity of endurance in those portions of the articular surfaces which are most accustomed to pressure. Fortunately also the straight position of both the hip and knee joints is that which, in case anchylosis were to ensue, would render the limb most useful for the purposes of progression. In and their swollen, painful, and stiff joints have resumed their functions completely.

The joint must first be subjected to passive motion, with sturdy rubbing; then to active motion. Faradization is not without its value, but it is second in importance to the measures first named. Nor must we be deterred by the pain which motion and rubbing may occasion; nor, indeed, by the temporary swelling which may ensue. A persistence in the same measures will generally conquer both, and sometimes very speedily.

If muscular contractions occur in the progress of the disease, with distortions of the limbs, they are to be overcome by the same means, namely, passive or active motion, or by extension with weights and pulleys, or by splints; and in extreme cases, when other measures have failed, by subcutaneous section of the tendons.

Hydrarthrosis, or water in the joint, seldom or never occurs except as a result of some form of inflammatory action; but it may be consequent upon a very low grade of inflammation, or persist after the subsidence of all signs of inflammation. Pressure with an elastic band or with a wet sponge, conjoined with the other general and local measures already suggested for chronic inflammation, will often prove sufficient. Tapping, injections of iodine, etc., notwithstanding considerable testimony in their favor, are remedies of doubtful propriety.

When pus forms, either in acute or chronic synovitis (*pyarthrosis*), prompt evacuation of the fluid, by early and free incision, is the proper remedy. There is no joint in the body to which this rule may not properly be applied, provided always the diagnosis is well made out, and the joint is within reach of the knife. At the present day no surgeon should consider his diagnosis as complete when the presence of pus in a joint is suspected, until he has introduced an exploring needle.

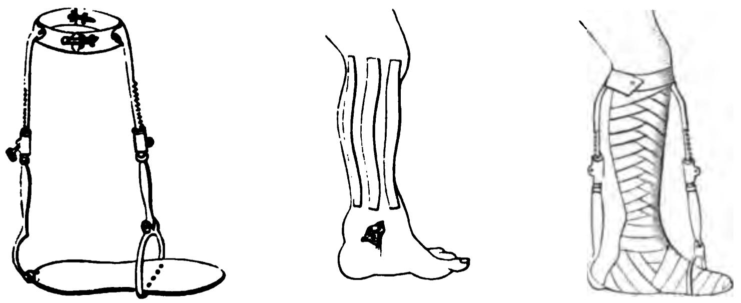


Fig. 191. Fig. 192. Fig. 193.

Sayre's Apparatus for extension at Ankle-joint.

Dr. Sayre has invented a very simple and ingenious portative apparatus for the purpose of making extension in certain cases of chronic inflammation of the ankle-joint. The instrument consists of a firm steel plate, made to fit the sole of the foot; at the heel is a hinge-joint, and attached to it a rod, slightly curved at the bottom, and extending up the back of the leg to near the knee. Over the instep is an arch, like the top of a stirrup, with a hinge-joint at its summit from which springs another rod, which runs in front of the leg, of equal length with the one behind. These rods are made with rachet and cogs for extension, and connected at the top by a firm band or collar of sheet-steel, admitting of adjustment by a slide, and which may be locked by turning the nut with the key. Firm adhesive plaster, cut in strips about one inch wide, and long enough to reach from the ankle to near the tubercle of the tibia, is placed all around the limb; the plaster is then secured in its position, to within an inch or two of its upper extremity, by a well-adjusted roller.

The foot is placed upon the steel plate and firmly secured by adhesive strips and a roller; the collar is closed and locked upon the leg just tight enough to be comfortable; the upper ends of the strips are brought over the collar and reversed upon the leg, where they are made fast by a few more turns of the roller. Extension is now made by turning the cogs with the key.

Ulceration of the Cartilages and of other tissues composing the articulation, is an occasional result of both acute and chronic synovitis. Its existence is rendered probable when, in strumous constitutions, the inflammation is greatly prolonged and the joint surfaces have become exquisitely sensitive; but we shall have more certain evidence of its presence when pus escapes from the joint and the probe detects the eroded and roughened bone, or when a distinct bony crepitus is developed by moving the joint surfaces upon each other. In this event three alternatives are offered:—

First, bony anchylosis; this, it need scarcely be said, is the most desirable alternative; and in order that it may be attained we secure to the joint absolute immobility, in that position in which the limb will be most useful if saved. Either leather, gum-shellac cloth, or plaster-of-Paris may be used for this purpose. The sinuses must be kept sufficiently open to permit a free discharge of the pus and débris; and after a time, in order to improve the general health, the patient may be permitted to go about upon crutches. When the disease involves the tarsal or carpal articulations, and has extended to the structure of these spongy bones, complete transfixion of the joint with a drainage tube, or with a seton of oakum, constitutes often an essential part of the treatment.

Second, excision of the affected joint; a measure which has been attended with the happiest results in its application to a large number of the joints of the body, but which is not to be considered so long as a reasonable hope remains that bony anchylosis may be accomplished. For a more complete consideration of this subject the reader is referred to the chapter on excision, and to the section on diseases of the hip-joint.

Third, amputation as a final resort, and only to be entertained when all other expedients have been considered and dismissed, or have been thoroughly tried.

SECTION 2.—CHRONIC RHEUMATIC ARTHRITIS.

Syn., Osteo-arthritis longa, R. C.; Chronic Osteo-arthritis; Rheumatoid Arthritis; Rheumatic Gout; when affecting the Hip-joint in old persons, Morbus Coxæ Senilis.

Under this great variety of terms medical and surgical writers have described a peculiar and well defined joint-affection, involving both the fibrous and bony tissues, and having some points of resemblance, in so far as the symptoms are concerned, to both gout and rheumatism; but the evidence is by no means conclusive that in a pathological sense it is related to either.

Chronic rheumatic arthritis may occur at any period of life, but it is most frequently met with in old men, especially in persons who have been much exposed to cold and to fatigue during a large portion of their lives. In women it is much less frequently observed; but it sometimes supervenes upon, or is associated with, menstrual irregularities, occurring at the periods of commencement or close of menstruation; while in other cases it seems to have had its origin in anæmia due to protracted lactation, or to other similar causes. I have met with examples which were plainly hereditary.

The hip-joint is especially liable to this disease, but it is occasionally seen in the knee and shoulder-joints, in the joints of the fingers and toes, in the temporo-maxillary articulation, and probably no joint of the body is wholly exempt.

Chronic rheumatic arthritis is characterized by pain and tenderness of the affected joint, which are greatly aggravated by motion. In the case of superficial joints, there is generally observed, at first, considerable swelling from effusion within the synovial capsule; but occasionally the malady progresses to its termination in complete anchylosis without any evidence of intra-capsular effusion. This latter variety has been termed "dry chronic rheumatic arthritis."

As the malady progresses, the effused fluids are gradually absorbed, while the epiphyses expand, causing, in the case of the fingers and in other superficial bones, node-like projections and distortions. In the case of the fingers the distortion usually presented is a deflection to the ulnar side.

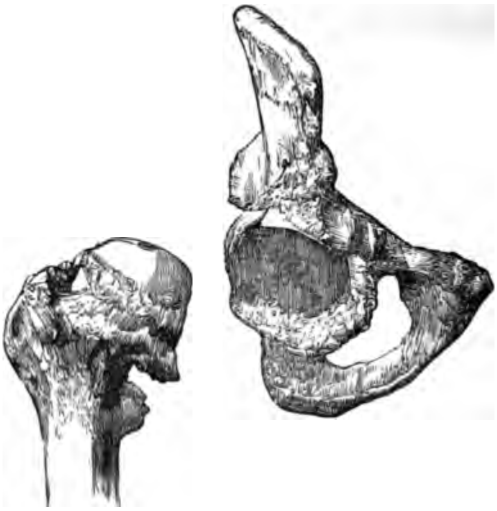
In most cases the disease is symmetrical, affecting the opposite or corresponding joints simultaneously; and when seated in the hip-joints, the patient has a peculiar and characteristic waddling or wriggling gait, occasioned by the almost complete immobility of the articular surfaces.

The pathological changes consist in an increased vascularity, with ickening of the synovial membranes and of the fibrous structures urrounding the joint; of increased secretion of the synovial fluid in he earlier stages, except in those examples termed dry rheumatic rthritis; and in the later stages, bony or calcareous deposits often occur within the joint. Portions or the whole of the synovial membranes covering the ends of the bones are eventually removed; the cartilages of incrustation disappear; and, in cases where limited motion has continued, the articular surfaces present a white and polished appearance like ivory (*eburnation*).

In other cases, where anchylosis is complete, the surfaces, upon being separated by force, appear rough and porous; short fibrous bands pass from one bone to the other, or the bony tissue itself is continuous between the opposing ends; the articular ends are misshapen, often overhanging at their margins, as if they had been soft like putty, and were flattened by pressure. In the case of the femur, the round ligament has usually disappeared, the head is moulded out of shape and depressed, the acetabulum is enlarged or elongated, the neck is shortened, and from the trochanters and intertrochanteric lines a crest of osteophites project upwards irregularly, forming, sometimes, a rudely-shaped coronet. The interior of the neck presents in most cases enlarged cancelli, penetrated with lines of compressed cancellous structure, resembling the interior callus of old fractures.

Considering the number and character of the changes which have occurred when this disease involves the head and neck of the femur, it

Fig. 194.



Chronic Rheumatic Arthritis of Hip-joint.

is not surprising that these curious specimens should have so often been mistaken for intra-capsular fracture united by bone. For a more full consideration of the true nature and interpretation of these museum specimens, the author begs leave to refer to his Treatise on Fractures and Dislocations, and especially to those portions relating to fractures of the neck of the femur within the capsule, and to fractures of the anatomical neck of the humerus.

Rheumatic arthritis might easily be mistaken for *chronic articular rheumatism*, in its earlier stages; but the stolid persistence of the former, the fact that it never leaves one joint to attack another, and the peculiar articular deformities which eventually take place, will after a time render the diagnosis certain.

Treatment.—The treatment must be both general and local. If possible, nutrition must be improved by proper hygienic measures, by the use of wholesome food, by air and by exercise, and by complete mental relaxation. In the case of females especial attention should be given to the condition of the uterine functions. As internal remedies guaiac, assafœtida, and other warm, stimulating, and diffusible agents most often give relief. Robert Smith recommends an electuary composed of guaiac, sulphur, bitartrate and carbonate of potass, and ginger, with a little rhubarb.

The local remedies are passive motion, when it can be borne without causing excessive pain, with warm stimulating embrocations made with the hands and repeated often. Swathing the joints with flannel or with stimulating plasters is also sometimes useful.

SECTION 3.—GONORRHŒAL AND SYPHILITIC ARTHRITIS.

Reference has been made to **Gonorrhœal and Syphilitic Arthritis**, in the chapters devoted to the special consideration of gonorrhœa and syphilis. The history of the case will generally be sufficient to determine the diagnosis, and to indicate the appropriate treatment.

SECTION 4.—GOUTY ARTHRITIS.

The enlargement of joints occasioned by the **gouty diathesis** are in most cases distinctive, and are not to be confounded with either of the articular affections enumerated. Gout is generally hereditary, and in these cases it seldom occurs before the thirty-fifth year of life; when acquired it may be developed much earlier. The smaller articulations, especially those of the fingers and toes, are more subject to gouty attacks than the larger joints; and, in a large majority of examples, the metatarso-phalangeal articulations of the great toes are primarily affected. The pains and the tenderness which accompany this malady are exquisite, and in many cases recur in paroxysms or "fits," at more or less regular intervals. The peculiar anatomical character distinctive of gout is the deposit of tophi, composed chiefly of the urate of soda, within and around the joint, forming incrustations upon the articular surfaces, ligaments, and even upon the tendons adjacent to the jo[illegible] As it presents itself in the joints, the affection is termed **Gouty Sy[illegible] vitis, Arthritis Nodosa**, or **Inflammatio Synovialis Podagr[illegible]** (R. C.). It is not regarded as a strictly surgical affection, and [illegible] therefore demand no further attention in this treatise.

SECTION 5.—HIP-JOINT DISEASE.

Syn., Morbus Coxæ, R. C.; Coxalgia; Coxarius.

Surgeons have, by common consent, included under this term several morbid conditions; or, perhaps, more properly speaking, certain morbid conditions having distinct and separate origins, but which are more or less liable to the same results, namely, suppuration, caries, and necrosis of the structures composing this articulation. Thus, for example, we are permitted, on the one hand, to include disease of these structures having a purely traumatic origin, such as those inflammations originating in violent strains or concussions, and, on the other, similar inflammations originating from a strumous diathesis, or occurring as sequelæ of fevers; again, on the one hand, we include those inflammations which may chance to be transient, or to terminate speedily in suppuration, and, on the other, those which are of a chronic character and whose final terminations are long delayed; the term embraces alike inflammations having their point of departure from the synovial membranes, the fibrous tissue, and the bones.

It will be noticed that in this category are included only those affections of the hip-joint which in their rise, progress, and terminations have so many points of resemblance that they cannot ordinarily be distinguished the one from the other; while all those affections which differ so essentially that their diagnosis is not usually attended with difficulty, such for example as chronic rheumatic arthritis, chronic articular rheumatism, gouty and syphilitic arthritis, are excluded.

These remarks, in reference to the meaning of the term "hip-disease," seemed necessary in order that the reader might comprehend the propriety of including under one term so great a variety of conditions, while, in the case of most other joints, more minute anatomical distinctions are made in the nomenclature. It arises from the necessities of the case. I am aware that surgeons have attempted to establish a more precise diagnosis, and especially to indicate the signs by which we may determine whether the morbid processes have commenced in the acetabulum (*acetabular arthritis*), in the head of the femur (*femoral arthritis*), or in the synovial, or fibrous structures of the joint itself (*arthritis*), and to establish upon this differential diagnosis a more accurate prognosis, and a more absolute plan of treatment.

Examples are now and then presented in which this degree of precision is possible, or in which we may at least arrive at approximate conclusions; but such opportunities are rare, and in most cases the diagnosis is only completed in the progress of the surgical operation which is made for the relief of the malady, or in the autopsy. The following are the chief differential signs:—

Arthritis.—When inflammation attacks primarily the synovial, cartilaginous, or fibrous tissues, it is usually of an acute character, occurring suddenly after a violent sprain of the joint, or after a long walk. The pain is at an early period intense and lancinating, and the patient is intolerant of the slightest pressure or motion. The limb becomes everted, abducted, more or less flexed, and apparently elongated as in other forms of hip-disease, but at a period much earlier. It occurs at all ages, but most often in persons below the middle of life.

These are the usual special phenomena of acute arthritis at the hip-joint; but in cases of a chronic character, originating in persons of strumous habits, or occurring without any appreciable external cause, the symptoms are less marked, and the lines of distinction between it and other forms of hip-disease cannot, in most cases, be defined.

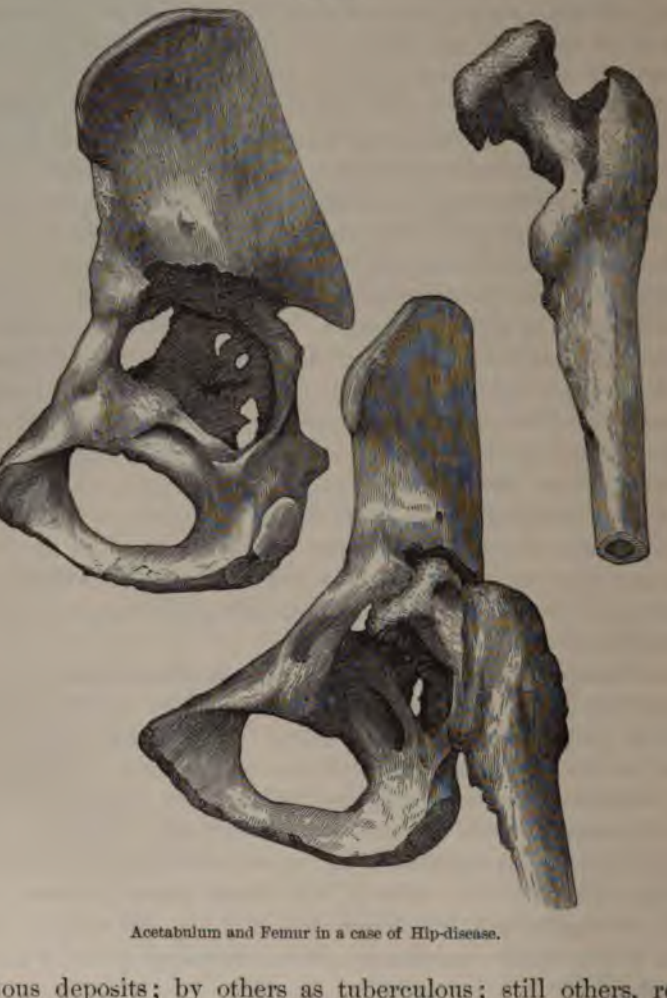
Acute coxal arthritis may terminate in resolution with speedy restoration of the functions of the joint; or it may proceed rapidly to effusions, first of serum and finally of pus, with rupture or ulceration of the capsule, and destruction of the whole interior of the joint, including the cartilaginous structures; portions of the bony structures may become carious and disappear, and finally what remains of the head of the femur may escape from the capsule and socket. In this condition the patient may survive many years and then recover without surgical interference, with a shortened, more or less deformed, and perhaps an anchylosed limb.

Acetabular Arthritis. Syn., Acetabular Ostitis and Periostitis.—When the disease attacks primarily the pelvic bones, the head of the femur may also, in the end, undergo considerable morbid changes, such as softening, caries, deformation, and possibly dislocation; but these results are less frequently observed, and the extent of the femoral lesions is usually more limited than in either of the other varieties. The characteristic symptoms, however, are such as are not usually seen or recognized until the malady has made great progress, namely, necrosis of various portions of the pelvic bones, intra-pelvic abscesses, and in a few cases penetration of the acetabulum by the head of the femur.

Acetabular arthritis, like arthritis, is liable to occur at any period of life. The prognosis is always unfavorable.

Femoral Arthritis. Syn., Femoral Ostitis and Osteo-myelitis.—Chronic inflammation invading primarily the upper end of the femur is probably the most frequent source of the so-called "hip-disease." Occurring most often in early life, and in children of a strumous habit, it is exceedingly insidious in its approach, and peculiarly intractable in its progress. It is essentially the same malady as that which, having attacked the lower epiphysis of the femur, or the upper epiphysis of the tibia, is known as "white swelling." The morbid changes which occur in the interior of the bone have been variously interpreted; by some the cheesy infiltrations are considered as strumous deposits; by others as tuberculous; still others, regarding scrofulosis and tuberculosis as identical, apply to these morbid products either one of these terms indifferently; but later pathologists recognize in them nothing more nor less than the infiltrations and degenerations of tissue consequent upon chronic inflammation, and in their nosology "white swelling" is circumscribed osteo-myelitis or ostitis, liable to be followed by solidification, expansion, suppuration, necrosis from strangulation, and caries. To this latter theory I do not hesitate, in view of the evidence now before me, to declare my

Fig. 195.



Acetabulum and Femur in a case of Hip-disease.

adhesion. Nevertheless, there can be no doubt that a strumous or a tuberculous diathesis constitutes an active predisposing cause in a large proportion of cases—a doctrine which is in no way inconsistent with the fact that in most examples the development of the malady may be distinctly traced to some apparently insignificant local injury.

The symptoms which characterize this variety may be considered as typical of the malady hitherto known and described as hip-disease, and from which the other varieties differ only in the degree and manner already indicated. An account of the symptoms and treatment, therefore, of coxo-femoral arthritis will demand more careful consideration.

Probably ninety per cent. of all the cases of hip-disease occur prior to the period of puberty, and generally between the ages of 2 and 10 It is very seldom, however, that the disease is manifested until after the child begins to walk; from which fact we may fairly infer that the immediate provocation is, in most cases, some local injury.

The patient is first observed to limp occasionally, especially after active exercise, or when he first rises in the morning; or he complains often of feeling tired, but when interrogated more closely he refers to a pain about his knee as the cause of his weariness and lameness. The pain now alluded to, and which is one of the most distinguishing features of the malady, although not always present in the first stage, is probably situated in those branches of the obturator nerve which are distributed to the knee, and is explained by the anatomical fact that the same nerve supplies the structures adjacent to the hip-joint. It is felt especially upon the inside of the knee, and is often particularly severe at night. During the whole progress of the malady, or at least until a very late period, this phenomenon is usually present. The pain is aggravated by attempts to straighten the thigh, and also by forced abduction or rotation outwards. Coincident with the occurrence of pain there is usually observed some tendency on the part of the patient to flex the thigh, especially when in the recumbent posture.

The symptoms now described indicate the initial period of the disease, during which the inflammatory lesions have invaded all the structures composing the joint, and, to a greater or less extent, the structures adjacent; but it is probable that neither suppuration, caries, nor necrosis have yet added their fatal complications, and a cure without deformity or maiming is still possible; indeed, with modern improvements in the surgical and therapeutical management of these cases, it is rendered probable.

The second stage is characterized by increased pain, apparent elongation of the limb, abduction, eversion, increased flattening of the nates; the gluteal fold is lowered and the internatal fissure is inclined toward the affected side. The motions of the joint are extremely limited or wholly abolished.

The inflammatory action has now resulted in abundant intra-capsular effusions, perhaps of serum, of serum with fibrin, or of pus. In case the inflammation has not exceeded the stage of serous or of sero-plastic effusion, a cure without deformity might still be possible; but if pus has actually formed, such a hope could scarcely be entertained. The solution of this question, so important at this moment in reference at least to the prognosis, could only be obtained by exploration, and this has actually been proposed and practised, both as a means of diagnosis and as a curative measure.

The third stage presses closely upon the second, leaving ordinarily but little time for hesitation, or for delay in the application of suitable remedies. The pus having formed, very soon finds some point of exit from the painfully distended capsule, its escape being followed by sensible relief to the patient, and with somewhat improved mobility of the joint. From this time forward the position of the limb is gradually but steadily changed; until at length, if left to the uncontrolled action of the muscles, the thigh becomes rotated inwards, adducted, and shortened; in short, it is found eventually in a position exactly the opposite of that in which it was in the second stage. The flexion alone remains unchanged. In some cases, however, flexion is increased and in others diminished. Meanwhile the pus makes its way to the surface, most often below the external trochanter or in the direction of the gluteal fold, but not unfrequently at other points of the periphery of the limb, and especially in the groin.

An examination of the joint at this period shows almost complete destruction of the whole of its delicate interior machinery, including the synovial membrane, the round ligament, the cartilages of incrustation, the fibro-cartilaginous rim of the acetabulum, and of more or less of the ligamentous structures; the head of the femur is eroded, partly removed by caries, or a necrosed fragment alone remains, completely separated from the neck and shaft; the acetabular cavity is enlarged, or elongated, sometimes perforated at its base; and in exceptional cases the remnant of the head which still preserves its attachment to the neck, or the decapitated neck, is thrust upwards through a rent in the capsule and thus completely dislocated upon the dorsum ilii.

If the patient survives these serious lesions, a cure may be accomplished, after the lapse of several years, the head or neck of the femur forming for itself a new and imperfect articulation upon the dorsum of the ilium, while the acetabular cavity remains elongated, permitting the head to slide up and down; or the cavity may become narrowed, osteophites may shoot from the neck and trochanters, forming buttresses toward the pelvic bones, which, while they limit the motions of the new joint, serve also in some measure as supports for the weight of the body. I have especially noticed the presence of these osteophites when a portion of the head of the femur, necrosed, remains loose in the cavity of the socket. In such examples as this latter, the patient may recover so far as to be able to walk about and attend to ordinary duties, but the fistula does not close nor can the cure be complete until the fragment of dead bone, however small it may be, is removed.

Treatment of Hip-joint Disease.—The more rational view of the pathology of hip-joint disease adopted by modern pathologists and surgeons, namely, that in all its varieties it is essentially an inflammatory lesion, simplifies greatly both its surgery and therapeutics. It is hereafter removed from the category of special maladies, having special and debatable indications of treatment. Whatever laws govern the progress and management of inflammatory lesions elsewhere are strictly applicable here. Rest, position, and hygiene is the simple formula for the treatment of incipient hip-disease; and when suppuration, caries, or necrosis have ensued, early and free evacuation of the pus, and thereafter reasonable delay, in order that nature may accomplish the removal of the decayed or decomposed structures; or, when nature is found to be inadequate to the accomplishment of this end, timely and judicious surgical interference constitutes the remaining resource of our art.

Having already considered the subject of the treatment of both acute and chronic inflammations of the joints in the section devoted to synovitis, it only remains to make a special application of the rules there announced to the treatment of inflammations involving the hip-joint.

Rest may be attained by decubitus alone, or by decubitus aided by the application of a long, carefully-moulded leather splint; and this is the method practised by many surgeons abroad, and which I have in many cases myself practised with success. As a means of securing immobility and proper position to the joint I have sometimes employed gutta-percha, gum-shellac cloth, or wire gauze; but at the present moment most American surgeons prefer decubitus with extension, effected by means of the weight and pulley. The advantages of this latter method are several: first, it secures immobility of the joint without the annoyance occasioned by a heavy and sometimes very uncomfortable splint: second, it antagonizes the contracted muscles, and removes to a great extent the painful pressure of the opposing articular surfaces—in other words, it is another means of securing rest: third, it prevents those distortions of the limb which are inevitable when the muscles are unopposed, and which are so difficult to overcome when they have once taken place: fourth, it insures for the limb the best possible position for usefulness, in case anchylosis finally takes place: fifth, it prevents in some measure the final shortening.

American surgeons usually employ for this purpose precisely the same apparatus which has been described as applicable to the treatment of fractures of the neck of the femur; the weight being apportioned to the age and endurance of the patient, and being removed from time to time as the comfort of the patient may seem to require. In general it may be said that the amount of weight proper to be employed will vary from three pounds to eight or ten.

In the first stage of the malady this simple measure meets every indi cation; unless we except such measures of general hygiene as the case may demand, and which must be varied according to the exigencies of the case; but there are many excellent surgeons who insist upon the value and importance of other local and constitutional remedies; thus, for example, our own great surgeon, Dr. Physic, thought it necessary to begin in all cases with large and repeated doses of cathartic medicine; the practice of applying blisters, setons, or issues, is almost classic, and less heroic surgeons have preferred to apply leeches, or to paint the skin with the tincture of iodine, or to anoint with stimulating liniments. I will not deny that a few sturdy patients may be benefited by cathartics; nor that issues and blisters have frequently given manifest relief to the pain, but I have reasons for believing that they have both much more often done serious and irreparable harm by their irritating and exhausting effects, especially when their use has been long continued; while the remaining remedies suggested are only straws, with which sensible practitioners, in a matter so serious, will not seek to amuse either themselves or their patients.

As a rule, the appropriate hygiene is found in plenty of fresh air, a moderate temperature, good, wholesome diet, and cheerful attendants.

Among those who employ extension in the treatment of this disease a question has arisen as to whether, in case the limb is found to be drawn out of position, and the acute stage is not yet passed, it is better practice to apply the extension at once, or to wait until the inflammatory symptoms have somewhat subsided, or, perhaps, until the case is nearly terminated. In my opinion the question admits of but one answer. If the distortion is permitted to remain it is likely to increase steadily, and there is much danger that it will become irremediable. It is better, therefore, to make the attempt to overcome the contraction of the muscles at once; but the force applied must be proportioned to the sensibilities of the patient, and the direction of the force must be, at first, in the direction of the axis of the limb, and not in the direction of the axis of the body. In order to accomplish the latter purpose, the pulley and weight may be used for extension, and the counter-extension may be made by a perineal band as well as by the weight of the body. If, happily, under a faithful trial of this method, the rigid muscles are made to yield, by gradually changing the direction of the extension, the limb may, at a later day, be brought into a line with the body.

Let it be understood that this method demands circumspection, with daily and hourly attention. It ought never, or, at least, not after the first few hours, to cause pain, but it must be pursued carefully and with frequent changes until the end is accomplished, or until it is fully determined that a result so desirable cannot at present be attained.

The length of time during which the patient ought to be confined to the horizontal posture must be left to the judgment of the surgeon: seldom less than four or six weeks, and in most cases a much longer confinement is justifiable or is absolutely required. The period will at th arrive, however, in which rest and extension must be regarded econdary to general measures of hygiene; a period in which the t position and exercise become essential to the preservation of th, and thus indirectly essential to the restoration of the natural tions of the joint and limb.

xercise, with immobility of the joint, may be obtained by the use of ches, and by the employment at the same time of a long gutta-per- , leather, or felt splint, or by the use of Barwell's or my own wire- ze splint, moulded to the outside or back of the pelvis and thigh. By simple method I have managed a great many cases and brought 1 to a satisfactory termination; and probably a large majority of pean surgeons adopt essentially the same practice to-day.

Fig. 196.

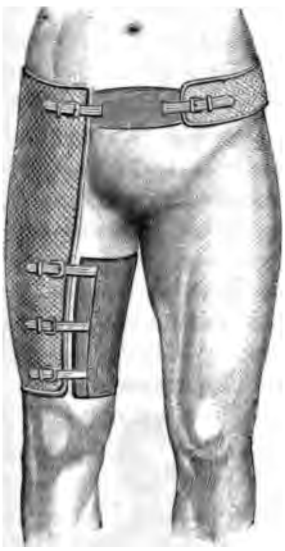
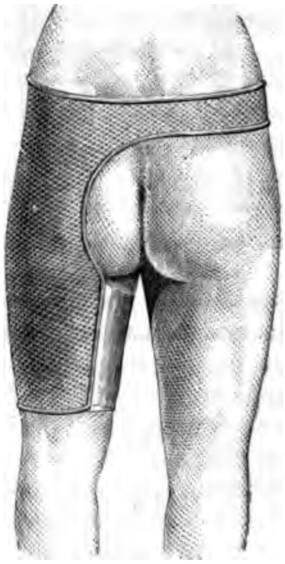


Fig. 197.



Author's wire-gauze splint.

1855, Dr. Henry G. Davis, of this city, announced a new method of ting hip-joint disease with a portative extension apparatus, by which roposed to combine mobility with diminished friction of the joint aces. I have already, when speaking of the treatment of chronic vitis, alluded to the importance of passive motion as a means of , whenever an attempt is made to re-establish the natural functions he part. It was precisely this end which Dr. Davis proposed to mplish by his apparatus.[1] Of the importance of the principle as ap- l to certain stages of the disease there can be no doubt, but as to competency of the apparatus to accomplish the end proposed there is some difference of opinion, and for this reason the portative apparatus first devised by Davis has undergone many changes in the hands of other surgeons, and Bauer, speaking of all those inventions designed to secure extension without interfering with the mobility of the joint,

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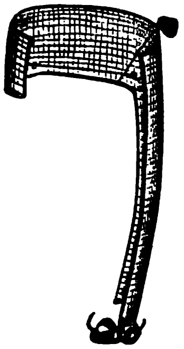
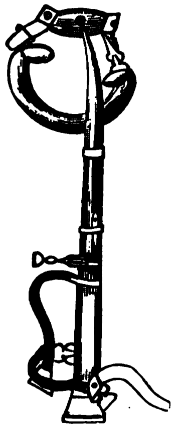
[1] *Conservative Surgery*, by Henry G. Davis, M.D. 1867.

Fig. 198.



Barwell's Wire Gauze Splint.

Fig. 199.



Sayre's Apparatus.

Fig. 200.

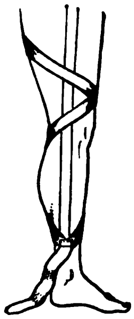
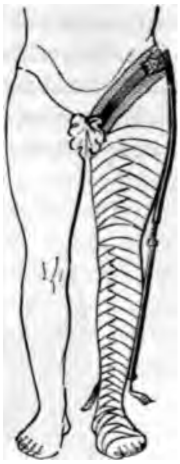


Fig. 201.



Davis' apparatus.

Fig. 202.

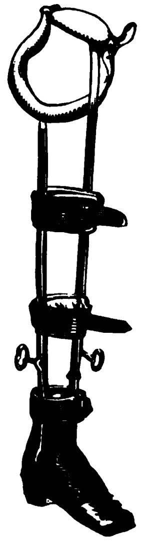
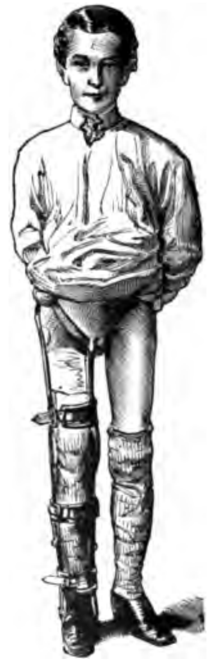


Fig. 203.

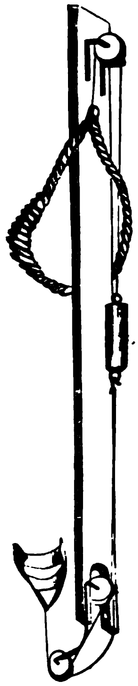


Bauer's apparatus.

says "the amount of extension exercised by them is very insignificant." He denies, moreover, that mobility is desirable, claiming, on the contrary, that the true purpose of a portative apparatus is to give "fixity" to the joint and at the same time extension; and he has accordingly constructed an apparel, such as is represented in the accompanying woodcut, in which extension is effected by a well-fitting laced boot, and counter-extension by a crutch-head placed against the tuber ischii. Two rods are employed instead of the one in Sayre's apparatus, and both are lengthened or shortened by the action of a screw. In both Davis and Bauer's apparatus extension is made from the foot; while in Sayre's it is made from above the condyles of the femur, and it is this peculiar feature which renders the latter lighter and more strictly portative than either of the others, but probably less efficient.

Without denying to each of these several forms of apparatus certain qualities of excellence, it seems to me quite certain that neither of them are entitled to the degree of unqualified confidence which their respective inventors appear to repose in them. Each form may have some special application to a particular case, but none of them are suitable to all the stages of disease or to all the exigencies which may arise.

Fig. 204.



Barwell's apparatus.

The simple wire-splint of Barwell and others, or the leather, felt, or gutta-percha splint, in which no extension is attempted, will serve in many of the uncomplicated cases, and especially during the first stage of the disease; the apparatus of Bauer, which, while it allows no motion at the hip-joint, makes effective extension, is preferable when the patient first leaves the bed after the employment of extension with the pulley and weight, in case the joint continues very sensitive; while the apparatus of Davis, or this apparatus in some of its modifications, which permits some motion at the hip-joint, is much to be preferred when the acute stage is fully passed, and when the restoration of motion assumes primary importance as an indication of treatment.

Barwell's attempt to substitute extension made by a long splint, with pulleys and an elastic cylinder, while the patient reposes in bed, for the American practice of using a weight and pulley, possesses none of the advantages claimed by him in his very specious argument, while it is much less simple and less easy of adjustment. I am persuaded that if this excellent surgeon will give the method we employ a fair trial he will be convinced of the truth of this statement.

Dr. Joseph C. Hutchison,[1] of Brooklyn, N. Y., declares that in his opinion the indications of treatment in these cases are: to secure immobility of the joint; to procure extension of the limb; to take off from it the superincumbent weight of the body; to provide means to enable the patient to take exercise in the open air. He believes that immobility is obtained by the rigidity of the joint, and that this continues until nature indicates that it is no longer necessary. To obtain extension of the limb and to remove the weight of the body he resorts to the following device: On the shoe of the sound limb an iron sole is applied, three inches high, so as to raise the foot from the ground. This elevated shoe and a pair of crutches constitute the apparatus. As the patient stands on his crutches the diseased limb is suspended. The shoe should be high enough to prevent the toes of the affected limb from touching the ground. By these simple means are fulfilled all the indications for the mechanical treatment for hip-joint disease. Immobility is obtained and friction prevented in the manner above indicated—chiefly by rigidity of the periarticular muscles.

There is much in Dr. Hutchison's argument and theory which commends itself to the judgment of the practical surgeon; but if the argument were less satisfactory, a practice which has received the formal approval of Dr. Hutchison is entitled to the serious consideration of surgeons.

The question of the propriety of operative interference has been considered in the chapter on excisions.

SECTION 6.—ANCHYLOSIS.

Partial or complete immobility of a joint may be due to a bony union and consolidation of the articulating surfaces; to the formation of fibrous bands between the opposing surfaces; to cicatrization and shortening of articular ligaments after traumatic injuries; to passive contraction of ligaments resulting from long-continued disuse of the joint; to contractions of muscles and of tendons; to adhesion of muscles or tendons to each other, or to adjacent tissues; to partial or complete dislocation of joint surfaces; to the displacement of fragments where the lines of fracture have encroached upon the articulation; to irregular deposits of bone or callus without complete union of the opposing articular extremities, and perhaps to other causes not enumerated.

Bony union, or complete consolidation of the opposing articular ends, is termed true anchylosis. To all the remaining forms of anchylosis the terms false, or spurious are applied.

True, or Bony Anchylosis is in all cases accompanied with some of the above-mentioned forms of false anchylosis. In general it is irre mediable, inasmuch as, if broken up, very little hope can be entertained that the articular surfaces will ever be restored. It is only, therefore, by the formation of a *false joint*, at some point adjacent to the natural joint, that relief can usually be sought.

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[1] Treatment of Morbus Coxarius by a New Method, by Joseph C. Hutchison, M.D., Surgeon to Brooklyn City Hospital; Surgeon-in-Chief to the Brooklyn Orthopædic Infirmary. *Amer. Jour. Med. Sci.*, Jan., 1879.

False Anchylosis is more or less amenable to treatment according to the nature and extent of the lesion, the pathological condition of the parts involved, and the length of time which has elapsed since its occurrence, or accession. It will be impossible to study all these circumstances in detail.

In most cases long-continued passive or active motion, aided by frictions, will accomplish something.

Where these measures fail, the application of force, sufficient to stretch again to their natural length the contracted tissues, or to disrupt new tissues, will often succeed in restoring the limb to its natural form. Under the influence of anæsthetics muscles and other structures, which are merely contracted, yield to the application of less force. By their power of abolishing pain, also, they have encouraged more frequent resort to this method, when it becomes necessary to tear asunder new structures, or even ligaments and tendons, which by long disuse have lost their normal extensibility.

Superficial tendons and muscles, which do not yield readily to the extending force, ought to be cut subcutaneously, rather than take the chances of tearing them asunder by greater violence.

When a limb has been restored to position by force, it must be subjected to passive motion daily and with great persistence, even although it may cause considerable pain, or the anchylosis will be reproduced; but if this result is found to be inevitable, the limb must at once be placed in that position in which, if anchylosed, it will prove most useful, and there maintained.

SECTION 7.—NEURALGIA OF THE JOINTS.

We occasionally meet with examples of neuralgia involving the joints or the structures adjacent, which are apparently due to a disordered condition of the whole nervous system, or to a hysterical diathesis. The knee, hip, ankle, and shoulder-joints are most liable to this affection. It is characterized by intense pain, occurring suddenly and sometimes disappearing with equal abruptness, occasioned not unfrequently by some slight twist or false motion, at other times by menstrual irregularities, or by mere mental emotion. Usually transient in its character, it is sometimes very persistent, causing, eventually, muscular contractions and distortions of the limbs. The seat of the pain or of the tenderness may be apparently in the articular surfaces, in the ligaments, or in the integuments surrounding the joints. In some cases passive motion causes acute suffering, while in others pain is caused alone or chiefly by pressure made upon the surrounding integuments. These constitute the usual positive signs of this affection; while the negative signs are a total absence of all the ordinary symptoms of inflammation in the affected joint, or of disturbance in such other parts of the body as are known to have sympathetic relations with the structures directly implicated.

Treatment.—General therapeutics furnish the only reliable means of cure. In a few cases gentle frictions, anodyne plasters, and Faradization give unqualified relief, and perhaps contribute to the cure. When the limbs have become distorted in consequence of the long continuance of the malady, forced extension under the influence of an anæsthetic, and permanent extension accomplished by means of splints or the pulley and weight, may become necessary.

Section 8.—Loose or Floating Bodies in Joints.

Allusion has already been made to the occasional presence of solid bodies in rheumatic and gouty joints; and also to the presence of fibrous, millet-seed bodies in bursæ, and in other synovial membranes. The bodies now under consideration differ essentially from either of the above mentioned; and are to be distinguished, also, from examples of slipping or displacement of inter-articular cartilages, to which allusion was made in connection with fractures. It seems probable that they must be regarded as having been originally outgrowths or examples of simple hypertrophy of structure, and in some cases as genuine neoplasms, which develop themselves in the serous or subserous membranes of the joint, possessing at first a fibrous or cartilaginous character; but in process of time the central portion ossifies, and as the body increases in size, it obtrudes itself more and more between the articular surfaces, becomes flattened, pediculated, and finally, by some sudden and violent motion of the joint it is completely detached.

The symptoms which indicate the presence of a floating cartilage, as it is usually termed, are a sudden loss of power, or inability to support the weight of the body, in the affected limb—attended in most cases by a sharp pain on moving the joint freely in one direction or another—the disability as suddenly disappearing, leaving, perhaps, only a slight degree of soreness. When the cartilage has become frequently engaged in this manner, between those portions of the articular surfaces which receive the weight of the body in standing, the joint is apt to inflame and swell, indicating intra-articular effusions. Upon careful examination, the floating cartilage can generally be felt, while it is lying near the circumference of the joint, and especially when it happens to be placed on either side, near the ligamentum patellæ.

Treatment.—In a large majority of the cases which have come under my notice, I have only found it necessary to recommend temporary rest in the horizontal posture, and the exercise of caution in the use of the limb when the patient again walks about; taking care, especially, not to put the limb in those positions, in which experience has taught him that the displacement is likely to occur. In other cases patients have derived benefit from the use of an elastic knee-cap, or from the application of a light and well-adjusted leather splint. Whenever the disturbance occasioned by one of these bodies seriously impairs the functions of the joint, or becomes insupportable, the patient will be warranted in taking the risks incident to an operation made for its removal.

The best point to seize and extract a floating cartilage is below the patella, upon the inside of the knee. While held in this position, thrust well down over the front of the tibia, the leg being flexed, a valvular incision is made from below, and it is forced out. The leg is now straightened, which allows the skin to fall downwards, completing the valvular arrangement; a large wet sponge is placed over the knee, the limb is laid upon a well-fitting splint, and the whole secured with a bandage.

Some surgeons prefer to open the synovial sac by a subcutaneous incision, and, having thrust the loose body into the areolar tissue, they permit it to remain beneath the integument. It is difficult to conceive what advantage this method possesses over that already described; inasmuch as the valvular form of the incision recommended in the first operation, protects the joint quite as effectually against the admission of air, as does the more complicated mode of procedure recommended in the last, and, at the same time, avoids the accidents which are always possible when a foreign body remains in the subcutaneous areolar tissue.

Let no one be persuaded, by a few successful examples, that either of these operations is unattended with danger. Anchylosis, suppuration, tetanus, loss of limb or of life, are the occasional results, against which no method of operation or amount of precautionary measures have hitherto been able to furnish an absolute guarantee.

CHAPTER XXII.

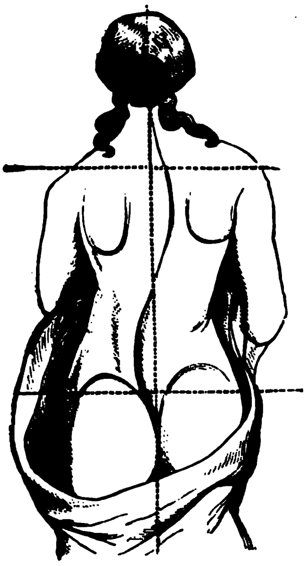
DISEASES OF THE SPINE.

SECTION 1.—LATERAL CURVATURE.

Syn., Skoliosis, R. C.; Scoliosis.

LATERAL curvature of the spine occurs chiefly in anæmic patients, although it is by no means limited to this class. Its usual period of invasion is at, or near the age of puberty: it is more frequently observed in girls than in boys: it is much more common in the northern and middle latitudes than in the tropics, where the people live habitually out of doors; it is seldom or never seen among barbarous and nomadic races; the children of affluence are its special victims rather than the children of poverty. In a large majority of cases the primary, dorsal curve, is to the right side.

Fig. 205.



Lateral Curvature.

Without entering into a discussion of the various theories which have been propounded in explanation of skoliosis, I shall state my belief that it is, in most cases, due to a want of correspondence in the antagonism of those muscles which control the motions of the spinal column; this condition consenting usually with general debility of the muscular system, and preternatural flexibility or diminished elasticity of the intervertebral fibro-cartilages.

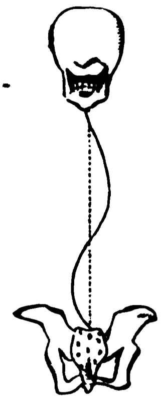
The earliest indication of lateral curvature, is generally seen in the increased projection of the right scapula; and in most cases, the dress-maker is the first to call attention to this condition. Upon careful examination it will now be noticed that when the patient stands erect, with the heels together, the middle dorsal portion of the spinal column is slightly curved to the right, and that there is also a corresponding deflexion of the lumbar and lower dorsal vertebræ to the left: the right shoulder is, at the same time, somewhat elevated, and the left hip is lowered and projects posteriorly.

When the malposition is moderate and recent, pressure upon the side of the chest, made by the hand, is sufficient to overcome the deformity: and even at a much later day it will disappear entirely in the supine posture.

When once the deformity has commenced, so that the weight of the head and shoulders no longer rests over the centre of gravity, its progress is usually quite rapid; the convexity of the two lateral curves is increased; and in some cases, two supplementary curves are formed, one in the cervical region, and the other in the lower part of the lumbar.

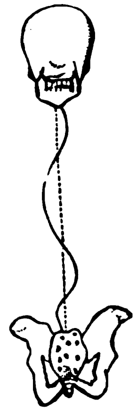
At the same moment that these lateral deviations are taking place, excepting only in those examples which occur in adult life, the spinal column undergoes double or quadruple rotation, the direction of the rotation, in each section of the column, being determined by the direction of the curvature. In all cases, the spinous processes are turned more or less in the direction of the concavity; so that, in cases of double lateral curvature, and when, as is usually the case, the dorsal curvature is to the right, the spinous processes of the same vertebræ incline also to the left; while the bodies of the lumbar vertebræ having rotated in the opposite direction, their spinous processes incline to the right.

Fig. 206.



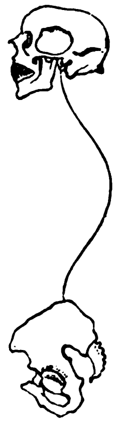
Double Lateral Curve.

Fig. 207.



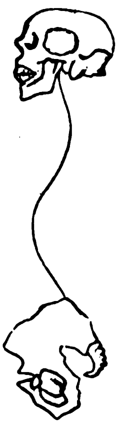
Quadruple Lateral Curve.

Fig. 208.



Cyphosis.

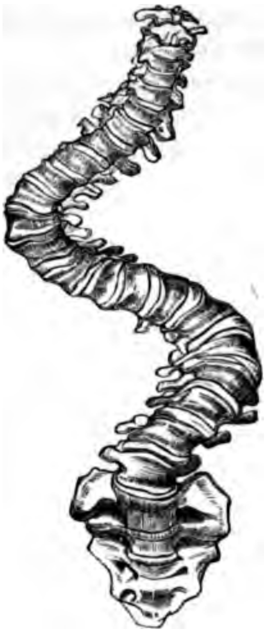
Fig. 209.



Lordosis.

Examples are now and then presented of spinal curvature, clearly dependent upon the same causes which give rise to the lateral curvatures, in which for certain reasons, not always easily determined, the direction of the several inflexions is antero-posterior instead of lateral; these examples representing exaggerations or modifications of the natural spinal curves. When the convexity of the curvature is posterior and is limited mostly to the dorsal region, the appearance presented is not unlike that seen in rickets, and it is named *cyphosis;* when the lumbar and lower dorsal vertebræ present a strong convexity forwards, it is termed *lordosis.*

Fig. 210.



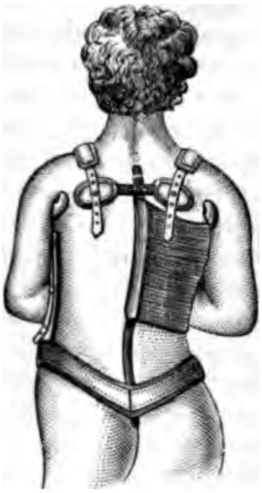
Lateral Curvature and Rotation.

Causes.—In a few exceptionable examples, the cause of lateral curvature may be found in some original or acquired defect of the pelvic bones, or of the lower extremities; which render necessary certain changes in the direction of the vertebral column, in order to preserve the equilibrium. In other cases, almost equally exceptional, the deformity is due to functional or organic disease of the thoracic or abdominal viscera. But in a large proportion of cases, the immediate cause is to be sought, in a gradual loss of equilibrium between those antagonizing muscles which control the motions of the spinal column; and which condition is induced by habitual inclination of the body to the one side or the other, in standing or in sitting, or to the habitual exercise of one set of muscles, while the opposite and corresponding muscles are at rest. As has already been intimated in the preceding pages, its remote cause is to be found, usually, in a depreciation of the tone of the general system.

Treatment.—In the early stages of this affection, a complete and rapid cure may often be accomplished, by the proper use of all those measures which are calculated to develop and equalize muscular power; and to this end, boys must be taken from the desk, the counting-room, and from the school-houses, where they are compelled to sit many hours each day upon benches without backs; girls must be taken from schools, where health is always held subordinate to deportment and scholarship; and both boys and girls must be sent to the fields, to romp and frolic like wild colts. Calisthenics, and gymnastics, and sober methodic drills may be of some little value in their way; but as measures of hygiene, and especially in their power to attain the results now proposed, they will bear no comparison with those free and unrestrained exercises in which the heart and muscles act in unison.

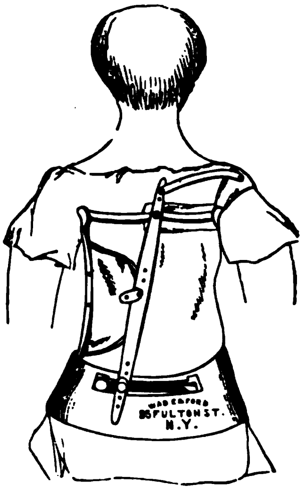
Cold water and salt water bathing, Faradization, frictions and good wholesome food are important adjuvants; nor must I omit to mention that very much of our success in any given case will depend upon the dress. Boys with crooked backs, and round shoulders, and pigeon-shaped chests cannot grow straight in a tight-fitting suit of broadcloth. A "healthy" suit of clothes is one in which the joints have free play, and which betrays no treacherous weakness in frog-leap; which is cool, and light, and not easily soiled. Girls cannot wade through the mud, or even walk over closely-trimmed lawns, before the sun has scattered the dews, with thin shoes, and trailing skirts; nor can they "make time" in corsets. If daughters are sent into the country to get health and straighten their backs, they must adopt the costumes of the people among whom they have come to live. If substantial hats are worn in certain rural districts, it is because in these places it sometimes rains; if men and women walk upon clogs or stilts, it is because the mud and marshes have suggested the necessity.

Fig. 211.



Tiemann's Apparatus.

Fig. 212.



Brodhurst's Apparatus.

In sitting, the back should always have a complete rest; and the patient should never be permitted to sit in a bent, or sideling position, but whenever he feels a sense of weariness in the muscles of the back, he should at once place himself in the supine posture upon a lounge or mattress. When sitting, also, in case the dorsal curvature is to the right, the left buttock should be elevated by an additional cushion, in order to encourage the muscles to restore the equilibrium of the spine.

It is only in the second or third stage of this affection that spinal supports can ever be useful. At all periods they are liable to serious objections, since no apparatus has yet been contrived which does not in some degree limit the freedom of motion, and thus compel certain muscles to fall into disuse; and some forms of apparatus come near converting the body into an automaton, so far as the action of the muscles is concerned. It is true, also, whatever specialists may say to the contrary, that, as mere mechanical levers, employed for the purpose of forcing the spine into the erect position, apparatus is able to accomplish but little. In what may be called the fourth or last stage, when the spinal column becomes fixed, and can no longer be made to yield under pressure, apparatus is useless.

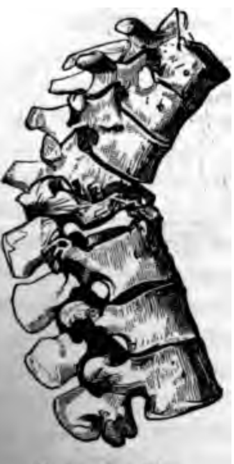
Among the various forms of apparatus contrived for lateral curvature, that recommended and employed by Brodhurst, and that constructed by Tiemann, will be found as efficient as any.

SECTION 2.—CARIES OF THE SPINE.

Syn., Kyphosis, R. C.; Tuberculosis of the Spine; Pott's Disease; Angular Curvature; Arthro-chondritis; Gibbus.

In most cases, the history and progress of this malady furnish very conclusive evidence, that it is of a tuberculous or strumous origin, especially, in those cases in which the disease is developed early in life, and the largest proportion of cases are met with before the sixth year. It is nevertheless true, that the immediate or exciting cause may generally be found in some fall, contusion, or other local injury, received perhaps several weeks or even months before the development or actual recognition of the disease.

Fig. 213.



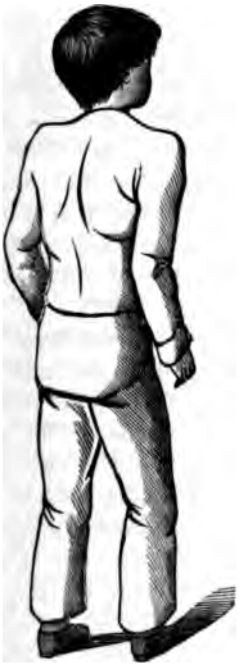
Caries of the Spine.

The inter-articular fibro-cartilages are probably most often primarily affected. In other cases, it is quite probable that the primary lesion is a tuberculous deposit in the cancellous structure of the bodies of the vertebræ. In either case, there is a gradual absorption, and disintegration of structure, until at length the affected vertebra becomes reduced to a mere shell, with perforated and crumbling walls, and it is crushed beneath the weight of the superincumbent column.

In a large majority of cases, vertebral abscesses are formed sooner or later, as a result of the caries; exceptionally, however, death ensues, or a recovery takes place, without the formation of pus. We have seen several examples illustrating this fact, and we especially invite attention to the case reported by Dr. Hutchinson to the New York Pathological Society, December 22, 1869, in which the destruction by caries involved large portion of the cervical vertebræ, yet in the autopsy, the presence pus could not be detected.

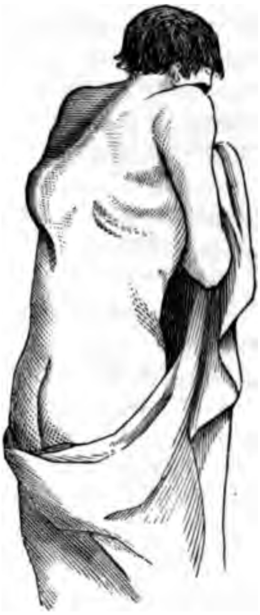
toms.—The disease is sometimes manifested before the child walk, and in these cases the first indication is, usually, a slight n of one of the spinous processes, most frequently of some one iddle or lower dorsal or upper lumbar vertebræ. The more observer may also notice a slight lateral incurvation, or a egree of fulness, extending over the space of two, three, or nous processes, preceding the more acute angular projection. ild is a little older and has learned to walk, it is first observed rips and falls easily; he does not raise his feet well in walking, fles and turns his toes slightly in, and at a somewhat later e spinal projection is discovered; the child complains of pains le, belly or legs; he is subject to spasmodic contractions of the luring sleep, and is restless, feverish, and fretful.

Fig. 214.



Incipient Caries.

Fig. 215.



Fully Developed Caries.

disease advances, one after another of the adjacent vertebræ nvolved, and their corresponding spinous processes project, upon the back an abrupt angular eminence; the appetite is s; the bowels are usually torpid, and the belly presents a pearance; the urine is, in most cases, pale and alkalescent. At d, and in most cases, from the earliest period in the progress of dy, the gait and general appearance of the little patient are almost characteristic. He walks with his head, shoulders, and pelvis thrown back, and slides along with the utmost caution, as if afraid of the jar caused by the quick and forcible descent of the foot. Whenever he attempts to pick any object from the floor, he refuses to bend his back, but attains his purpose by some ingenious change of position. While standing, he usually supports himself with his hands upon his knees, and with his body bent forwards from the hips.

I should do injustice to these unfortunate patients, if I omitted to call attention again to what may be regarded as one of the earliest signs of this disease, and the timely recognition of which may sometimes enable the surgeon to avoid wholly the angular deformity; namely, a slight lateral deviation of a single spinous process, or a fulness or oval projection, extending over the space occupied by two or three vertebræ, and which probably indicates the softening of the inter-vertebral fibro-cartilages prior to their destruction.

As we have already stated, suppuration is by no means a constant attendant upon arthro-chondritis, although it is the usual result. In a certain number of cases, and especially, we have observed, when the disease occurs in adults, and there is no marked strumous or tubercular diathesis, a cure is accomplished, after considerable angular distortion has taken place, without the formation of pus.

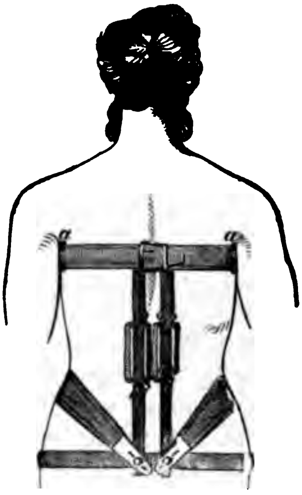
When pus forms the prognosis is less favorable, but nevertheless there is abundant experience to encourage a hope, that a cure will ultimately be accomplished by the solidification and fusion of the adjacent vertebræ, and by the formation of a true external callus or vertebral splint.

The history, symptoms and management of these vertebral abscesses is fully considered in their appropriate place. (See Abdomen, etc.)

Treatment.—It is unnecessary to indicate the general treatment in a case of this character; except to say, that whenever the malady is based upon a strumous or tuberculous diathesis, every therapeutical and hygienic measure must be employed to invigorate the system, and improve the general health. In this case, as in strumous disease of the hip-joint, air, light and exercise constitute essential means of cure; and here, also, absolute rest and freedom from pressure for the inflamed and disintegrating structures, are necessary conditions of success. Rest, with relief from the pressure of the superincumbent weight, may be obtained by lying upon a mattress in the prone or supine position; but, in order to combine with these conditions healthful exercise and an abundance of pure air, mechanical supports are required.

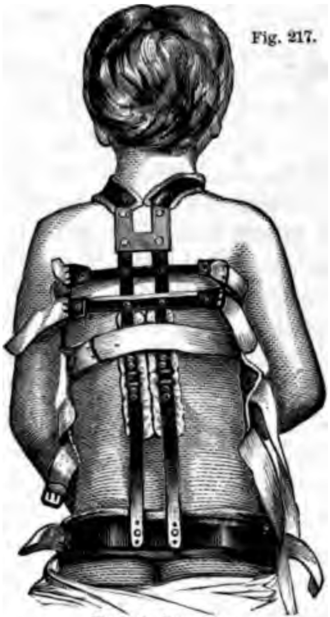
The principles which ought to govern the construction and application of mechanical supports, in cases of caries of the spine are: the greatest degree of lightness, compatible with the requisite firmness; accurate adaptation; pressure in opposing directions upon the spinal column, sufficient to insure support and steadiness, and to transfer, in some degree, the weight of the spinal column from the affected vertebræ, to their corresponding oblique processes, while at the same time these vertebræ shall not be separated from each other in a manner to defeat the end desired, namely, their final union and consolidation by callus;

Fig. 216.



Davis' Apparatus for Caries of the Spine.

Fig. 217.



Taylor's Apparatus.

the pressure being so applied on either side of the spinous processes, and not upon the processes themselves, as that it shall cause the least pain or pendulous belly; interfering in no way with the free motions of the arms or legs.

The plaster-of-Paris dressing employed by Dr. Sayre is applied in the ollowing manner: The person to whom it is to be applied being divested f his clothing, a close-fitting knit shirt is drawn over his body and hips. He is then suspended by the head and arm-pits until only his toes rest upon the floor. While in this position a roller, into the meshes of which dry plaster-of-Paris has been rubbed, after soaking two minutes in water, s applied from the top of the trochanters to the arm-pits. Over this hree or four additional thicknesses of roller are laid, each successive ayer being rendered smooth by the hand. After ten minutes the patient may be taken from the suspension apparatus and laid upon a hard mattress for three-quarters of an hour. The clothes may then be resumed.

This mode of support is simple, inexpensive, and often useful, but it s liable to some serious objection, and is far from being able to accomplish all that its advocates have sometimes claimed for it. In many cases other forms of apparatus ought to be preferred.

Whatever may be the form of apparatus employed, when the caries is at or above the middle dorsal vertebræ, some additional support for the head, neck, and shoulders will be required.

SECTION 3.—CLEFT SPINE.

Syn., Spina Bifida, R. C.

Spina bifida is a congenital affection. It may present itself upon any portion of the spinal column, or the spine may be cleft through its entire length, but in a large majority of cases it is limited to the lumbar region. By most writers, it is spoken of as simply an example of arrest of development. It is questionable, however, whether the arrest of development is not in most cases, perhaps in all, a result only of a diseased condition of the spinal membranes, in consequence of which an excess of arachnoid fluid is formed, and the fusion of the spinal plates prevented by mechanical pressure.

The integument covering the tumor formed by the protruding membranes is, in some cases, quite like integument in other parts of the body; at other times it is thin and parchment-like; or there may be a complete absence of tegumentary covering, the meninges themselves presenting upon the surface. The sac may connect with the spinal cord by a narrow or a large opening, and the tumor may consequently assume a pediculated or sessile form. The contents of the sac are in most cases nothing but a thin, transparent, watery fluid—the subarachnoid. In a few examples, the sac has been found to contain more or less adipose and connective tissue.

Mr. Holmes asserts, that in the common position of the spina bifida, the cord, or some important portion of it, is almost always contained in the sac. And Mr. Hewett says, that he found only one such preparation out of twenty, in which the nerves were not connected with the sac. When the cord, or its caudal prolongation, is thus implicated, it is always closely united to the posterior wall along the median line, and the nerves pass laterally in either direction, enclosed in the posterior and lateral walls, toward their final destination.

The tumor is generally elastic and may be somewhat reduced in size by pressure, especially when the patient is in the recumbent posture and under such circumstances the tension of the fontanelles may be increased, or, if the patient is hydrocephalic, the circumference of the head may be enlarged. Moderate pressure usually causes no apparent inconvenience, but in other cases it occasions convulsions or temporary paralysis.

The prognosis will vary somewhat according to the size of the tumor, its rapidity of growth, the appearance of the integument, and upon the presence or absence of other complications. In a large majority of cases ulceration soon takes place, convulsions ensue, and the patient dies. In a few examples we have seen a spontaneous cure effected, and in one case under my observation the patient has survived, notwithstanding the gradual and continued growth of the tumor, to adult life.

Treatment.—The obstacles to the successful management of these cases are: first, the fact that in not a few examples, to say the least, the primary and essential malady is a diseased condition of the arachnoid membranes, over which neither local nor constitutional remedies have much control; second, the danger of propagating inflammation tc the contents of the spinal canal by all strictly surgical expedients; third, the occasional, and, according to Mr. Holmes, the frequent presence of the cord and of the spinal nerves in the arachnoid sac.

How to overcome or to shun these impediments has for a long time been the subject of careful inquiry and experiment, but we cannot say that very much has hitherto been accomplished. We still feel it our duty to advise only an expectant course in all cases which do not threaten a speedy dissolution; but when the tumor is observed to increase with rapidity, or paralysis with convulsions are fairly announced, it will be proper to resort to some one of the authorized surgical expedients.

Tapping with a fine needle or with a small trocar and canula, frequently repeated, followed by moderate pressure made by means of a pad and bandage, or by collodion plaster, has occasionally proven successful. In order to avoid, as far as possible, injury to the spinal cord or nerves, in case they should be involved in the tumor, the tappings should be made remote from the median line. If the integument is very thin, and collodion is employed, Behrend recommends that it shall be mixed with equal parts of castor-oil. The mixture should be spread on very thick, and allowed to dry completely before the child is dressed.

Velpeau, Brainard, and others have succeeded by combining the operation of tapping with injections of iodine. Brainard declared that he had cured three cases by this method. His plan is as follows: having first placed his patient under the influence of an anæsthetic, a portion only of the fluid is drawn off; when a small quantity of a solution, composed of iodine five grains, iodide of potassium fifteen grains, and water one ounce, is injected. This is allowed to remain a few seconds and then withdrawn. Next the sac is injected and washed out with tepid water; and finally, a portion of the subarachnoid fluid, which has been retained and kept warm, is injected, and pressure applied.

Excision, the removal by the écraseur and rapid ligation by the ligature, have all been suggested and practised, but not with results which would encourage a repetition.

The gradual obliteration of the neck of the sac, by an elastic or moderately tight ligature, is less hazardous, and has occasionally proven successful, but it is only applicable to cases in which the pedicle is narrow. In three or four cases, in which I have made trial of this method, no good has been accomplished.

(Spinal distortions, due to *Rachitis*, have been considered in connection with other general diseases of the osseous system.)

CHAPTER XXIII.

DEFORMITIES, NATURAL AND ACQUIRED.

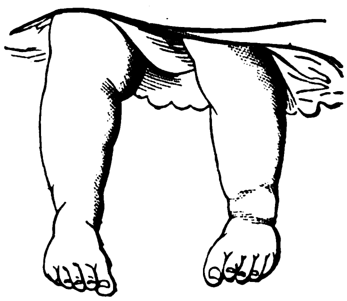
Club-foot. Syn., Talipes R. C.

There are four principal varieties of club-foot, namely: varus, valgus, equinus, and calcaneus. Systematic writers have also of late recognized several subordinate varieties, namely, equino-varus, equino-valgus, calcaneo-varus, and calcaneo-valgus. To which may be added plantaris, or pes cavus.

Talipes Varus.—Of the four leading varieties enumerated above, talipes varus is by far the most frequent, and will therefore demand the first consideration. But it must be observed that varus is almost always associated with some degree of equinus. It would be more correct, therefore, to speak of equino-varus as the most frequent variety. Both the primary and the subordinate variety will be included in the following history.

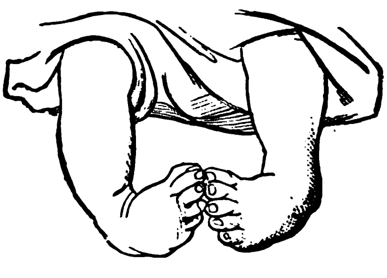
The position of the foot is not identically the same in different cases; but it differs according to the degree of shortening of the muscular and tendinous structures. It will be convenient to speak of varus, therefore, as existing in the first, second or third degree. In the first degree there is but little more than that amount of inversion which has been called "pigeon-toe." In the third degree the foot is twisted inwards until the big toe can be easily placed against the inside of the leg; the foot is rotated inwards upon its long axis, and when the patient stands erect, the outer and upper portion of the tarsus rests upon the ground; the

Fig. 218.



Double Talipes Equino-Varus. 1st Degree. (Same as Fig 219; after 5 months' treatment.) Sayre.

Fig. 219.

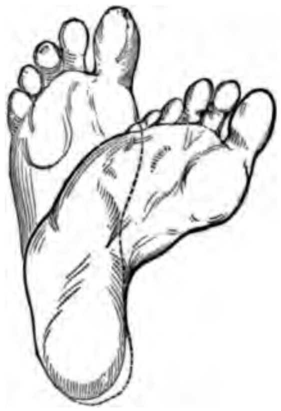


Double Talipes Equino-Varus. 3d Degree. (Before treatment.) Sayre.

foot is extended upon the leg and the heel is drawn up. In the second degree the foot occupies a position intermediate between these extremes.

At birth the anatomical malformations are in most cases very trivial; but in the progress of time, and especially after the patient begins to use the limbs in progression, they are more apparent. The shortened muscles become more contracted and active, while the elongated muscles increase in length and frequently decrease in strength; the tendons become displaced; the ligaments upon one side shorten and grow more compact, and upon the opposite side they suffer elongation; the bones of the tarsus, and especially the astragalus, in old and extreme cases, undergo material changes in form; and finally, even the integument is shortened upon the inner side to a degree that would render immediate restoration of the foot to its normal position impossible, if every subjacent tissue was divided. A careful observation will show the statement of Sayre to be correct that the principal seat of malposition and distortion, in most of the forms of talipes, but especially in varus, is the middle tarsal articulation,[1] a fact which finds a ready explanation in the great latitude of motion enjoyed by this compound enarthrodial joint.

Fig. 220.



Malposition of Medio-Tarsal Articulation, in Varus. Sayre.

In addition to distortion of the foot, as a result of the causes inducing talipes, there is in most cases a lack of circulation and of nutrition, not limited to the foot, but extending usually to the entire leg and thigh; in consequence of which, the affected foot and limb fail to develop in the same proportion as the corresponding sound extremity. Eventually the foot will be found to be smaller, and the limb somewhat shorter than the opposite. This may be due in some measure to the original defect; but it is mostly due to the imperfect use of the limb, as is shown by the effect of exercise, and of restoring the natural form of the foot, in preventing these results.

Various theories have been suggested in explanation of congenital club-foot; but among them all there is only one which is sustained by a sufficient weight of testimony to entitle it to respectful consideration, namely, that it is due to disturbed innervation; in consequence of which, at some period of fœtal life, the balance of power between antagonizing muscles is lost. It will be noticed that in the case of club-foot, as in most other analogous congenital deformities, the direction of the displacement almost invariably corresponds to the most active muscles. The extensors and adductors of the foot are, in their normal state, much more powerful and active than the flexors and abductors; and it is only necessary to assume a slight additional loss of equilibrium, either from diminished innervation of the one set or from increased innervation of the opposite, to understand why varus should be of such frequent occurrence. It is quite probable, then, that the former condition, namely, diminished innervation, or a moderate loss of the normal activity of the opposite muscles, is at the foundation of most cases of congenital talipes; precisely as we observe that diminished innervation is the usual source of acquired talipes, as it occurs during early life, in consequence of the so-called infantile paralysis.

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[1] **Sayre.** *Practical Manual on the Treatment of Club-foot*, by Lewis A. Sayre, M.D., Prof. of Orthopædic Surgery, Bellevue Hosp. Med. Col., etc., etc. Appleton, 1869.

Treatment.—To the question, At what period of life is it best to commence the treatment of varus? I reply, at the earliest possible period. At birth the deformity has already been in progress for some time, but unfortunately the child has not hitherto been within the reach of surgical aid. There is no reason, however, why the earliest opportunity should not be seized when no obstacles are interposed. The delay of a month may make very little difference in the final result, but it is enough to know that it makes some difference, inasmuch as the deformity, once commenced, is, so far as my observation extends, always progressive.

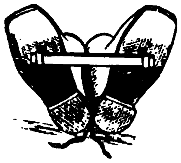
The nurse should be instructed to manipulate the foot daily, and thus seek to restore it to position; it must not be farther distorted by swaddling clothes, but left loose and free, until the skin has become a little hardened by exposure. As early as the eighth week the surgeon may begin to aid in the restoration, by the application of adhesive plasters made to encircle the ball of the foot, and from thence extended to the leg. The precise manner of applying these adhesive strips need not be explained, since no surgeon of ordinary ingenuity will experience any difficulty in their application. Splints made of gutta-percha, moulded to the foot and leg while the parts are held in position, will often accomplish all we desire in varus of first or second degree. Felt, leather and plaster-of-Paris may be used for the same purpose; and with one or another of these simple measures, persisted in a few weeks or months, I have brought many simple cases to a speedy cure.

In case the varus does not sensibly improve under this management, and the child has attained the age of four or six months, other mechanical appliances must be brought to our aid.

With nearly all forms of apparatus which do not extend above the knee, great difficulty is experienced in preventing rotation of the foot inwards: indeed, in most cases, they accomplish little or nothing beyond straightening the foot upon itself, and turning its plantar surface downwards and outwards. The extension of the apparatus to the thigh, or to the thigh and body, remedies this difficulty; but the complexity and weight of such dressings render them wholly inapplicable to :s and young children.

:ase both feet are affected with varus, I have found a much more ; and satisfactory remedy in the following arrangement. Both re placed in Scarpa's shoes or in common laced boots, each one of oes or boots being supplied with a steel loop or fenestra, placed iely under the part corresponding to the ball of the foot. The eing placed in the shoes, the heels are tied er by a string, and a bar of steel, furnished , shoulder at each end, and about four or five in length, is inserted by its two extremities ie loops, pressing the toes well apart.

Fig. 221.

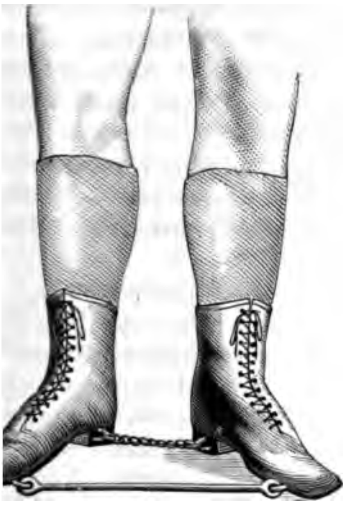


Author's Apparatus.

some cases, where I have experienced much lty in the management of the case, I have ed to the same expedient in varus affecting but ot. No harm comes of this arrangement so far use of the muscles is concerned. Indeed they are usually ren- more active by the resistance offered to their free motion.

ippears from a statement made by Dr. Atlee to the American al Association, in May, 1868, that Dr. Henry Neil, of Philadelphia, employed a similar method, using for this purpose a piece of thin strong board shaped to the sole of each foot, and united by a cross-bar; the whole being made of one piece of board. These wooden soles were then bound to the bottom of the shoes, or of the feet.

Fig. 222.



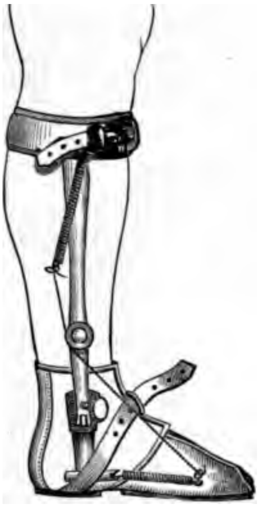
Dengler's Apparatus.

Mr. Dengler, orthopædic instrument-maker of this city, has extended this idea to the treatment of cases in which the patients are walking about, the heels being left free, and the inter-pedal bar being connected with each shoe by short chains.

The shoes, constructed with elastic rubber, or coiled wire-bands as substitutes for steel springs, and with a joint in the the shoe, to allow of greater lateral movement, are useful modi- is of Scarpa's original shoe: but the absurd contests maintained n rival instrument-makers as to priority of invention, without settled the points in dispute, have served to give undue impor- o their suggestions, and to lead the public to imagine that these s were radical and revolutionary.

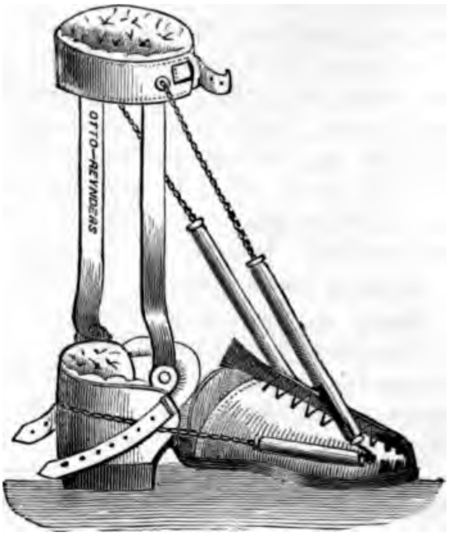
The lateral hinge is an old contrivance, and its value is limited t those cases in which effective pressure cannot be made upon an incu vated foot by bands or elastic springs. Bigg claims to have introduced elastic bands as a substitute for springs in 1854; and Barwell has more lately greatly extended their application. Most American surgeons and orthopædists, including Sayre, Andrews, Prince, Davis, and others, have adopted, with more or less modifications, the views and practice of Barwell. In a large proportion of cases the plan is possessed of real advantages; but the claim that this or any other plan of mechanical support leaves the muscles and joints wholly free from restraint is unfounded.

Fig. 223.



Tiemann's Modification of Scarpa's Shoe.

Fig. 224.



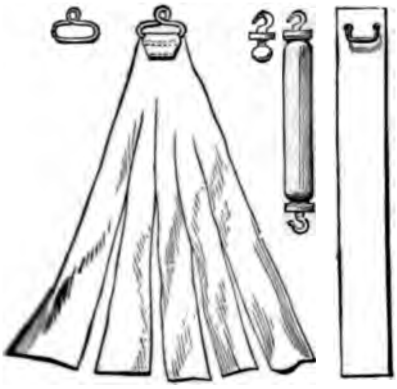
Sayre's Modification of Scarpa's Shoe.

Of the various modifications of Scarpa's shoe there is none better than that constructed by Mr. Tiemann, of this city, with a high boot having a movable sole, an adjustable ankle-joint, a single upright bar, and a cord attached to spiral springs; or that constructed by Sayre, with two upright bars, a ball and socket joint under the hollow of the foot, and in which India-rubber tubing is substituted for the coiled wire.

I must not omit to mention Mr. Barwell's ingenious mode of combining adhesive strips and elastic bands, for the purpose of adjusting club-feet. His method is as follows:—

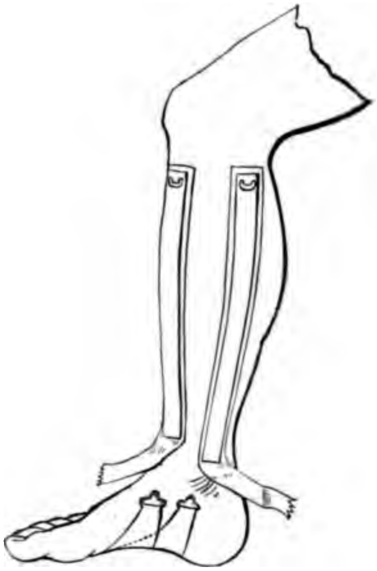
One or two triangular pieces of adhesive plaster, cut as shown in the accompanying drawing (Fig. 225), and fastened to wire loops, are laid under the sole of the foot (Fig. 226), two long strips are laid upon the side and front of the leg, and reinforced by a strip of tin having at its upper end a loop (Fig. 227). The longitudinal adhesive and tin strips are then secured above by circular strips of adhesive plaster, with slots to receive the loop: at the lower end, the plaster is reversed upon the tin, and secured also by circular adhesive strips and rollers. By the aid of a couple of small chains and India-rubber tubing the upper and lower loops are connected, and the adjustment of the foot effected. It need scarcely be said that these plasters will often become loosened and will require frequent readjustment, but so long as they remain in place their effect is all that could be desired.

Fig. 226.



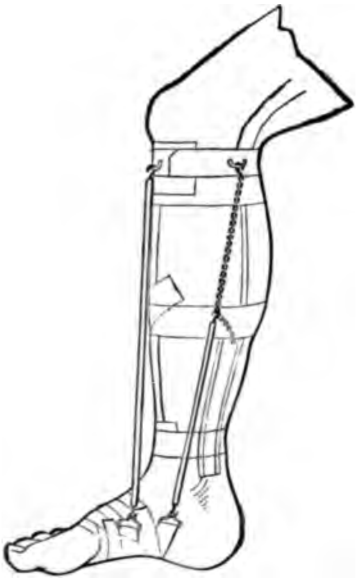
Strips and Loops.

Fig. 225.



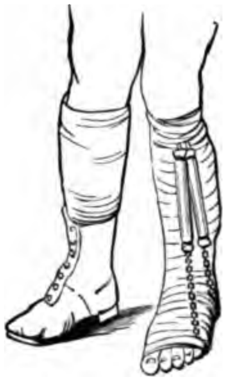
Strips and Loops in position.

Fig. 228.



Chains and Tubing attached.

Fig. 227.



Dressing Complete.

I have not hitherto spoken of tenotomy as a means of overcoming deformity in club-foot, because I desire it to be regarded as a last resort. Not that we ought always to wait until all other measures have been tried; but that we ought never to resort to tenotomy when there is a reasonable prospect that manipulation or mechanical appliances will succeed. The great advantages of this method in certain cases were first established by Stromeyer in 1831. Since this time the operation has enjoyed a remarkable reputation, and until quite recently all other means of overcoming club-foot deformities have been regarded as only secondary to tenotomy. To-day a strong reaction has taken place, and chiefly, I think, through the influence of the writings of Barwell; indeed there would seem to be some danger that the reaction tended to the exclusion of tenotomy altogether. For myself I take some satisfaction in saying that my opinions have not much or at all changed, inasmuch as I have always regarded tenotomy as an important and indispensable resource in some cases, but as wholly unnecessary in others: in short, tenotomy, in my practice, has always occupied a position secondary and subordinate to other measures.

There is no tendon, whose contraction interferes with the restoration of the foot, which may not with propriety, under certain circumstances, be cut; but it will perhaps prove a better guide to the young surgeon when I say, that section of the tendo Achillis is most often required, and most often furnishes positive results. After this, the tibialis anticus and posticus most frequently demand division. Division of the plantar fascia, no doubt advantageous in a few examples, has seldom fulfilled my expectations.

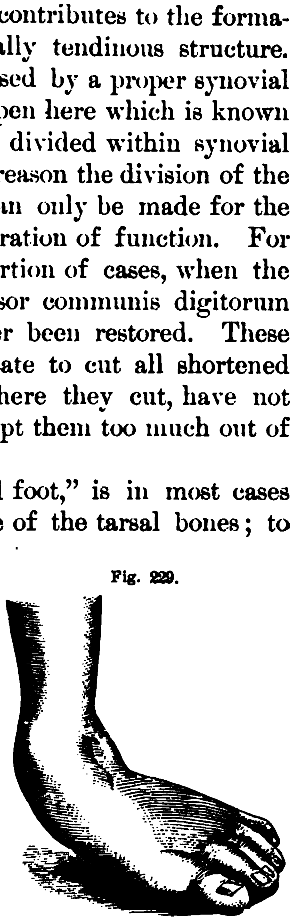
In dividing the tendo Achillis I employ usually an ordinary tenotome, and placing the patient upon his belly, an assistant steadies and renders tense the tendon by forcible flexion of the foot. The integument is then lifted or drawn to the opposite side, while the point of the knife is entered from the proximal side, between the skin and tendon, and the division is effected by carefully estimated pressure and a slight sawing motion, the edge of the knife being directed toward the bones. The tendon beginning to yield, the flexion of the foot is increased, and slight pressure upon the knife is continued until the separation is complete. There need be no hesitation in forcibly restoring the foot to position at once, and in thus separating widely the ends of the divided tendon. Nor, I may add, need there be any delay when the dressing is completed, in applying the proper mechanical apparatus, and thus holding the ends of the tendon well apart. Union occurs as speedily when this method is pursued as when other and more dilatory measures are adopted.

There is some danger in this operation of wounding the posterior tibial artery or its malleolar branches, but this danger is not lessened by introducing the knife beneath the tendon; while the danger of transfixing the integument, and of making only a partial division of the tendon, is thereby increased.

The refinement of this operation which some orthopædists pretend to practise, namely, dividing the tendon without dividing its capsule, is simply impossible; nor is the suggestion based upon any correct docrine of the process of repair in the divided and separated structures. The new or intermediate tendon is not necessarily formed from the nterior of the sheath, nor indeed is it exclusively a projection of new issues from the cut and separated extremities. All the connective isue, which has suffered lesion, adjacent to the cylindrical canal ormed by the withdrawal of the divided ends, contributes to the formaion of the new, at first cicatricial, and finally tendinous structure. ortunately the tendo Achillis is seldom enclosed by a proper synovial heath. If it were, the same thing would happen here which is known o happen elsewhere—whenever tendons are divided within synovial anals—no union would take place. For this reason the division of the exor and extensor tendons of the fingers can only be made for the elief of deformity, but with no hope of restoration of function. For e same reason, also, in a pretty large proportion of cases, when the bialis posticus, tibialis anticus, and the extensor communis digitorum ave been divided, their functions have never been restored. These re facts which orthopædists who do not hesitate to cut all shortened endons, and without sufficient regard to where they cut, have not eemed to understand, or they have at least kept them too much out of ight.

Valgus.—Eversion of the foot or "splayed foot," is in most cases cquired, and is due generally to some disease of the tarsal bones; to eakness of the internal lateral ligaments; paralysis of the flexors and adductors; or an accident, such as a fracture of the ternal malleolus, or a rupture of the delid ligament.

Fig. 229.



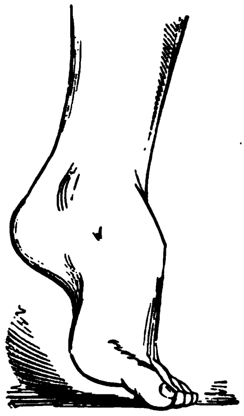
Talipes Valgus.

Flat-Foot is a variety of the same affecn, being due in most cases to a yielding of e ligaments which sustain the tarsal arch.

Treatment.—Originating from so great variety of causes, the treatment must be cessarily varied to meet the exigencies of e case. Ordinarily, except where it occurs early life as a consequence of simple rexation of the articular ligaments, and a eneral deficiency of muscular power, or as a consequence of infantile aralysis, it is incurable. In the first class of cases mentioned, however, e cure is often effected spontaneously as the child grows and beomes more robust, or by manipulation, frictions and careful exercise f the limbs in progression. When it is due to infantile paralysis, arwell's apparatus, or any light apparatus constructed with elastic ands, which do not interfere with the exercise of the muscles, will be ound serviceable.

Equinus.—Extension of the foot upon the leg may be caused either y paralysis of the extensor longus digitorum pedis, of the tibialis anticus, and peroneus tertius; or by contraction of the muscles which terminate in the tendo Achillis, as in cases of chronic muscular rheumatism, and in certain examples of reflex nervous action. It is in most cases an acquired deformity, and not unfrequently disappears when the exciting cause has ceased to act.

Fig. 230.



Talipes Equinus.

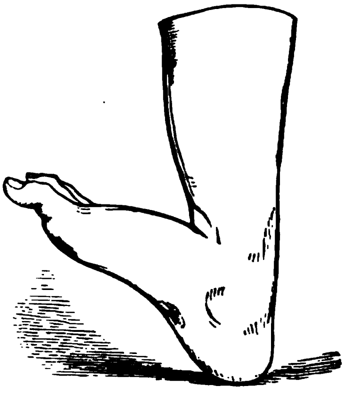
Treatment.—Frequent manipulation, and especially the application of force when the patient is rendered insensible by anæsthesia, will in most cases accomplish a cure. Apparatus can also in these cases be applied with great advantage, inasmuch as there is no difficulty in obtaining points of support for the application of the forces. When other measures fail, section of the tendo Achillis accomplishes a speedy and complete restoration of the foot. If, however, the deformity is due to paralysis alone, restoration of position is not usually followed by restoration of function; and, indeed, it is doubtful whether the utility of the limb for the purposes of progression will not by this operation be rather diminished than increased. Tenotomy must, therefore, not be practised in these cases, until after a full consideration of its probable consequences.

Calcaneus.—Paralysis of the sural muscles is the most frequent cause of calcaneus. It may be either congenital or acquired.

Treatment.—Attention must first be directed to the removal of the immediate or exciting cause, after which, or while the limb is subjected to appropriate therapeutical measures, mechanical appliances may be required to aid in the restoration of the foot to its proper position.

It may be necessary to repeat that in neither valgus, equinus nor calcaneus, is there usually any malformation of the bones, and that in nearly all cases which can be regarded as curable the treatment is mainly directed—on the one hand, to the restoration of the functions of enfeebled or paralyzed muscles, or to the strengthening of weakened ligaments—and, on the other, to the lengthening of tendons and of muscles. In calcaneus, tenotomy is seldom practised.

Fig. 231.

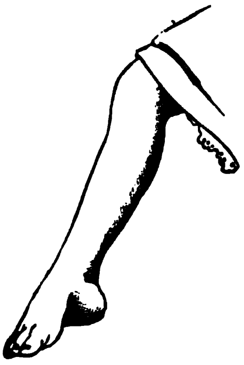


Talipes Calcaneus.

Talipes Cavus, or **Plantaris,** is in many cases a complication of varus; but, occasionally, it exists independently of any other form of pedal deformity.

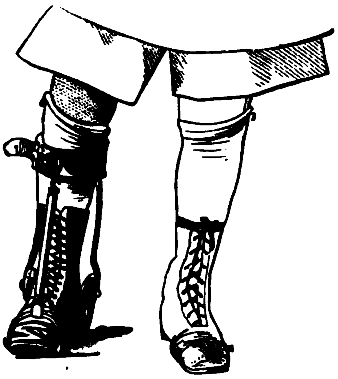
As the term talipes cavus implies, it is characterized by an extraorinary hollowing of the foot. It may be due to an injury and conseuent contraction of the plantar fasciæ and muscles, or to paralysis of ne extensors of the toes and consequent falling of the lower portion f the foot. The first is termed *plantaris traumatica*, and the latter *lantaris paralytica*. In the former case a cure can only be effected y free section of the plantar tissues, including generally the integunent; and in the latter case, Barwell's adhesive strips and India-rubber ands will answer most completely all the indications.

Fig. 232.



Talipes Plantaris Paralytica.

Fig. 233.



Apparatus applied for same.

Bony Anchylosis with Deformity, at the Hip-joint.—In 1870, Mr. William Adams, of London, made a successful attempt to straighten a high anchylosed at an inconvenient angle, by subcutaneous section of the one. The limb could not be made straight, however, until after a secion of several muscles also, and it subsequently became again completely nchylosed. In making the operation, Mr. Adams first introduced a elicate knife to the bone, and along the incision thus made, he carried narrow, straight saw serrated only for an inch and a half at its end, nd with this the section of the bone was made from before backwards. n a similar case Mr. Maunder has used a narrow chisel for dividing the one. The idea of sawing the bone in such a way as to make a true cket is specious, but hardly sound, inasmuch as the extremities of e sawn bone undergo a change in form by absorption and bony deposit. In a case of this kind, the surgeon must expect to encounter other stacles than the resistance presented by the bony anchylosis. Muscles, ndons, and ligaments have become shortened, and by section or force eir resistance must be overcome, and inasmuch as about all that will gained is that the limb will be made straight, or at least straighter an before, the surgeon may well consider carefully before resorting to is operation.

Bony Anchylosis with Deformity, at the Knee-joint.—This subject as been considered in connection with excisions at the knee-joint.

Knock-Knee, or Genu Valgum, occurs mostly in strumous or rickety children. It is seldom congenital, but usually first manifests itself when the child begins to walk. Not unfrequently, as the muscles of the child increase in strength, the deformity gradually disappears.

The treatment consists in the employment of means to improve the general condition of the system. The child should have the aid of a wheel crutch when he begins to walk, and if the valgus is considerable or increasing, the limb should be supported by mechanical appliances constructed with movable joints at the knee. In no case, in my opinion—certainly in only a very exceptional case—will the surgeon be justified in removing by the saw a triangular section of the head of the tibia, as has been recommended and practised, nor in making a section of the external lateral ligaments.

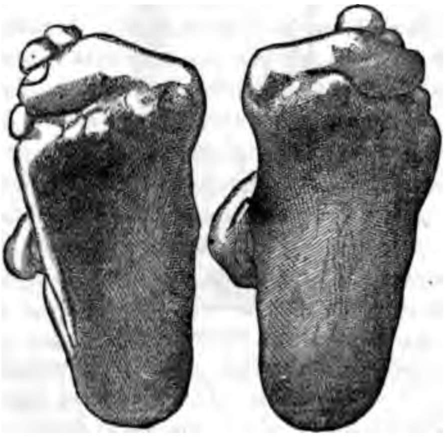
Bow-legs.—This is a condition in which the external lateral ligaments of the knee-joint have not only suffered some elongation or stretching, but the shafts of the tibia and fibula have become bowed outwards. It is due chiefly to a rachitic diathesis, and while it is not always possible to prevent or overcome the deformity wholly, yet by the judicious use of hygienic measures, by the use of a wheel-crutch in the first attempt to walk, and by mechanical appliances, very much can be accomplished. Recently, in a considerable number of obstinate cases, surgeons have practised successfully a surgical operation, which consists in removing a triangular piece from the centre of the shaft of the tibia by the saw, the section involving only about half of the diameter of the bone; the operation being completed by breaking the remainder of the bone, and then applying splints as in a case of fracture. The operation is much less dangerous than the similar operation to which reference has been made in the vicinity of the knee-joint, but, like any other compound fracture, it is not without its dangers.

Hallux Valgus, or Abduction of the Great Toe.—This deformity is caused generally by the habit of wearing shoes which are too narrow or too short. In a few exceptional cases it is due to a rheumatic or neurotic condition of the muscles, or to a chronic arthritis (arthritis deformans). Occasionally the deformity is such as to interfere seriously with progression, and in all cases it occasions such a projection of the joint as to cause inconveniences, giving rise to arthritis, periostitis, bunions, and hypertrophy of the head of the metatarsal bone.

Surgeons have attempted to overcome this deformity by mechanical appliances intended to maintain the toe in its natural position. As applied to such examples of this deformity as are met with in adults, which are due to improperly constructed shoes, and are of long standing, this plan of treatment is wholly useless. In addition to the hypertrophy of the capitulum, my own dissections have shown that the form of the capitulum, and of the articular surface are greatly changed, this latter presenting outwards instead of downwards in the direction of the axis of the bone. The articular ligaments have also undergone material changes.

Hueter, in the first edition of his Treatise on Diseases of the Joints, in 1870, says that he has several times made resection of the capitulum of the metatarsal bone for caries of this joint, and suggests that it might be made advantageously in certain cases of serious deformity, but so far as I am informed, no one made this operation solely to overcome a deformity until it was made by myself. Johann Lang, æt. 24, a baker by trade, was received into St. Francis Hospital, New York, on account of a valgus hallux in both feet, which prevented him from working at his trade. I operated March 31, 1873, upon the right foot, and on the 2d of June the same operation was made upon the left foot. A few months later the patient found himself perfectly cured. The toes occupied their normal position, and he was able to walk long distances without fatigue or discomfort.

Fig. 234.



Case of Lang before the operation.

Since the date of this operation I have operated several times and with uniform success.[1] Others have followed my example and with like results. In my earlier operations I adopted the long incision made by Hueter in cases of caries, and divided the bone with the bone-cutters, but I found, as have others, that the bone-cutters were apt to splinter the bone and cause delay in the cicatrization. In my later operations I have proceeded in the following manner: An incision is made upon the inside of the great toe so as to form an oval, or quadrilateral flap with its base toward the heel, about one inch and a half long and three-quarters of an inch wide. This being lifted, exposes the articulation completely, and its separation is easily effected. With the knife and the periosteal elevator, the head of the metatarsal bone is more completely exposed. A chain saw is now slipped over the end of the bone, the capitulum is steadied by a pair of bone forceps, and the section is easily effected.

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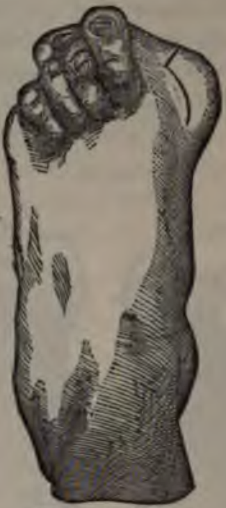
[1] *Medical Record*, Aug. 1, 1873; April 15, 1874; Jan. 9, 1875; Jan. 30, 1875. Transactions Amer. Med. Assoc., 1878, Vol. xxix., pp. 307, 327.

No ligatures or sutures are required, the flap being simply replaced the toe laid in position unsupported, without even bandages or c presses. During the first week the parts are to be kept envelope

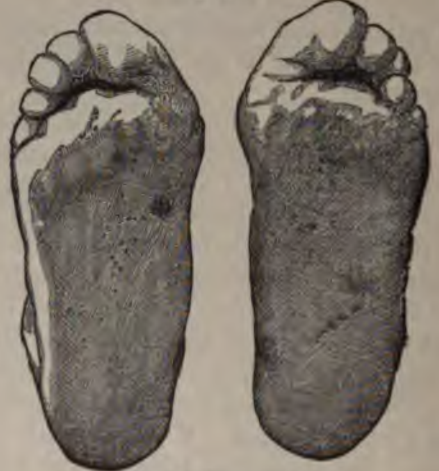
Fig. 235.



The first incision.

warm water fomentations, and after this, simple cerate or vaseline d ings are all that will be required. The only fatal case which has to my knowledge was one in which the warm water fomentations omitted.

Fig. 236.



Lang after the operation.

The same general plan of treatment is applicable to any of the toes in case they are deformed.

Ingrowing of the Toe Nail.—The affection which is usually thus designated is in fact an up-thrusting of the flesh, occasioned in most instances by narrow shoes. In strumous or delicate persons it often gives rise to an irritable and very painful ulceration.

Relief is obtained by wearing wider shoes, by touching the irritable ulcer with the nitrate of silver, by crowding lint carefully under the edge of the nail, by shaving the nail longitudinally so as to make it flexible, or by evulsion of a portion or the whole of the nail, but if a more prompt, efficient, and permanent cure is desired, it can best be obtained by either one of the two following methods:—By a single incision a portion of the flesh which has been pushed up against the margin of the nail should be removed. The subsequent process of cicatrization will draw the integument out and down, and thus remove the pressure upon the nail; or, the surgeon should remove by a double incision, commencing two or three lines back from the root of the nail, both the margin of the nail and its matrix. Care should be taken to include the portion of the matrix which incloses the root of the nail, as well as that which underlies the body. Only a small portion of the superabundant flesh need be removed. The wound thus made is closed by a few turns of a narrow roller, and a complete cure is usually effected in a few days. These operations, both of which, I believe, are original with me, have been practised by me for many years, and with unvarying success. In general I have given the preference to the method last described.

CHAPTER XXIV.

TUMORS.

Tumors may be classified with reference to their intimate structure, that is, histologically, or with reference to their clinical history and terminations, including the question of their innocence or malignancy. It is even possible to form a very general classification upon the nature of the tissues or organs from which they originate; since certain anatomical structures exhibit a constant tendency to the production of one class of pseudo-plasms, while other structures show a like tendency to the production of others.

No doubt, in a scientific point of view, it would be most proper to adopt that arrangement and nomenclature which has reference solely to the minute anatomical structure of the morbid growths; and by pathologists this has been attempted, yet rarely, I think, with satisfaction to themselves. Certainly they are very far from having united upon what should constitute the basis of a histological classification, and they are still farther from agreement as to the signification of each variety of structure, and as to the appropriate nomenclature. Billroth has declared that he did not think such a classification possible, or even desirable: and he has quoted J. Müller as saying "the microscopical and chemical analysis shall, therefore, never become the means of clinical diagnosis; it would be ridiculous to wish, or to suppose this possible." Billroth adds, "It is my endeavor not only to gain for pathological histology an independent position and a purely anatomical ground, but also to reinstall surgery, in regard to the diagnosis of tumors, in its full rights, which it had for a time too willingly given up."[1]

For these sentiments the author was severely censured by certain distinguished pathologists; and in one of his later treatises he has made the following qualified renunciation of his earlier opinions in regard to this matter: "Although I am still of the opinion that we should not cease seeking for a physiological (etiological-prognostic, clinical) recognition of the process on which the formation of tumors depends, and although I should even now esteem a division of tumors on physiological-genetic principles more highly than one on anatomical-genetic principles (which was Virchow's idea in his wonderfully classic work on tumors), still I abandon further attempts in this direction, and follow the anatomical principles in classification."[2]

The German writers especially, whom we must regard as our most progressive students in whatever pertains to histology and pathology, adhere rigorously to the system finally and reluctantly accepted by Billroth; while most English and American writers, among the first of whom is included Mr. Paget, continue to retain in great part the clinical classification. For myself I cannot but hope that hereafter, in the progress of chemical and microscopical observations, the doctrines of pathological histogeny will become definitely settled, and that the inconsistencies of histological and clinical facts will be fully reconciled; nor do I see any objections to pathologists adopting for themselves, even now, a system of nomenclature which is consistent with their own peculiar line of investigations, but there is not sufficient ground for its acceptance at present by those who are pursuing the study of practical surgery. For our purposes that arrangement is the best which, by a judicious combination of the several systems, will most facilitate the study of diagnosis, etiology, prognosis and treatment. To this end it has been generally found convenient to speak of encysted and solid tumors; of tumors of the soft, and of the hard parts; and of tumors benign, transitional, or recurrent and malignant.

In the present chapter most of the tumors will be considered in a manner by no means exhaustive, yet quite as much at length as is consistent with the limits and scope of a strictly surgical treatise: inasmuch, however, as it will be necessary to refer to them again in connection with the several regions of the body where they are most liable to occur the more complete study of some will be reserved for those chapters which relate to regional surgery.

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[1] *Classification, Diagnosis, and Prognosis of Tumors*, by Theodore Billroth, 1859.

[2] *General Surgical Pathology and Therapeutics*, by Theodore Billroth, Professor of Surgery in Vienna. Amer. Ed., 1871, p. 563.

Simple or Barren Cysts, originating in the Areolar or Connective Tissue.

These tumors form in all parts of the body wherever connective tissue has been found; and while it is quite certain that the mode of origin is not the same in all cases, yet such is the difficulty of determining, when a cyst is formed, its precise textural source, that they can only be described under one general division. Thus, for example, a certain number are known to be formed out of the expanded and hypertrophied spaces of the areolar tissue; or, the septa between adjacent spaces being broken down by the pressure of the accumulated fluid, or becoming displaced and attenuated, a cyst-wall is created, having an interior secreting surface. The most obvious examples of this formation are the *accidental* bursæ which are produced occasionally on various parts of the body in consequence of the sliding of the skin, and the consequent enlargement of the areolar spaces; but it is probable that a large proportion of other encysted tumors, and especially the hygromata, originate also from the same anatomical structure. The observations of Rokitansky and of others have demonstrated, also, that serous sacs, and many other forms of cystic growth, are capable of being developed directly from the elementary granule, or from the primitive connective-tissue cell, through some defect in the areolar germ.

Cystic tumors of this class contain, not as might be supposed, materials of a uniform character, but, on the contrary, the consistence and color, the physical and chemical constitution of the enclosed elements are exceedingly various: hence some have been called *serous cysts*, or more recently *hygromata*, others *synovial*, *mucous*, *sanguineous*, *oily*, *colloid*, etc.

1. Simple Serous Cyst.—Syn., Cystis Serosa, R. C.; Hygroma.

The most important general surgical observations relating to simple serous cysts are that they often grow rapidly and may attain a great size: their walls are in general thin; they present usually a smooth, round or oval, well-defined surface; they are unattended with pain or tenderness; the skin is not discolored, and, unless the sac is very much distended by its contents, they have an elastic feel, and may even fluctuate; they are seldom malignant, perhaps never, yet they may be associated with malignant formations, as happens occasionally in the breast, ovary, and testicle; most of those cysts, however, which are found parts of the body; most of them are accidental; they are less often enlarged than the deep or superficial bursæ.

Enlarged Bursa Patellæ. Syn., Bursa Patellæ Amplificata, R. C.; Hygroma du Genou.—The most frequent and typical example of enlarged superficial bursæ, is the enlarged bursa patellæ, or "housemaid's knee," which, as this popular name implies, occurs quite frequently on the knees of women who kneel and scrub floors; but I have seen them about as often in men as in women, caused sometimes by kneeling, as in the occupation of laying grates, and laying down carpets, and at other times by blows upon the knees or other similar injuries.

Enlargement of the patellar bursa may take place suddenly—when it is usually attended with some tenderness and perhaps discoloration. In these cases a termination in suppuration is not unfrequent; the pus usually extending beyond the limits of the original bursa, and involving the whole subcutaneous areolar tissue surrounding the knee, but seldom or never penetrating the articulation.

In most cases the enlargement progresses very slowly, and is unaccompanied with anything like inflammatory action. The form of the tumor usually corresponds pretty nearly with the form of the patella, covering, however, a little more space and being nearly circular. It is distinctly elastic, except when the sac is very thick, or in such rare examples as have become solidified.

As I have already observed in my general remarks on bursal tumors, the contents of these cysts are not uniform. In most cases they contain either serum or a sero-muculent fluid, thin and slightly opaque. Velpeau has remarked that he had generally found the fluid sanguinolent, or stained by blood. I have only seen this condition of the fluid in exceptional cases. Sometimes it is of a dark chocolate color; in which examples, also, it is probable that the discoloration is due to the presence of a certain amount of decomposed blood.

In addition to the fluid contents, there are frequently found within the sac bundles of long, slender, thread-like cords, some of which continue attached to the walls, while the remainder lie loose in the cavity: or there may be found small, loose bodies, of a flattened oval shape, and light-brown color, resembling melon-seeds; the interior may become converted into a solid fibrous mass; and, finally, the fibrous stroma may be in a great measure substituted by calcareous, cretaceous, cartilaginous or bone-like deposits.

The question having arisen whether patellar bursæ generally exist as a normal condition in adults, I have made a number of dissections with the view of determining this point, and also for the purpose of investigating other points connected with their anatomy and pathology.[1]

Over the patella of a child two months old the areolar tissue was loose, the spaces being large, but there was no bursa. In a child one year old there was a bursa of the size of a ten-cent piece. A child at five years presented a small bursa over the left knee, but none over the right, and another at the same age had a small bursa upon both. In more than twenty dissections of adults, the bursa has always been found covering from one-fifth to the whole of the patella. It is generally most complete over the lower portion of the patella, where one large cell is usually found; while over the upper portion there are one or more smaller cells. The cavity is, therefore, in a pretty large proportion of cases, multilocular. In those who were advanced in life, the interior margins or angles of the sac were usually crossed by delicate, fibrous-looking bands, attached at either end, and which bands generally contained one or more small blood-vessels. These were especially found at the lower half of the cavity; at the same points, also, flattened bands, or plates, lying one above the other, traversed the sac.

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[1] Observations on the Bursa Patellæ, by the Author, *The Medical Record*, April 15, 1868.

The connective tissue is everywhere very vascular, and, when pressed outwards by the growth of any form of tumor, whether fluid or solid, which does not, as in the case of malignant growths, involve and appropriate to itself this tissue, the vessels accumulate and form a kind of placenta around the tumor. If, however, the tumor commences, as in the case of most superficial bursæ, by a deposit of fluid in a number of areolar spaces at the same moment, forming at first a multilocular tumor, the intervening septa, with their vessels, become stretched and form thin plates, which by attrition of the movable integument are eventually reduced to cords or filaments, such as we see in healthy bursæ, but more numerous in the diseased bursæ, just in proportion, as in these latter cases, the spaces are larger and the walls more separated.

Finally, some of these attenuated plates or cords rupture, and their vessels pour out a few drops of blood; while their broken extremities coil up, and at length are cast off entirely, forming the free masses of coiled threads.

We have thus explained in a satisfactory manner the existence of the fibrillated masses which have been thought to be effused and rolled up fibrin; and also the occasional presence of blood in the bursæ.

The solidification of these growths, and the presence of the flattened oval bodies, which Mr. Brodie thought were formed from the effusion of coagulable lymph, will likewise admit of easy explanation. The solidification into a fibrous structure is in part due to a concentric hypertrophy of the walls, and in part to development from the interior vessels and septa of this originally multilocular cavity. The loose oval bodies are the results of an arborescent growth from the lining membrane and septa; the terminal bulbs of their stems and branches becoming flattened, and finally detached; previous to detachment, however, they may have become converted into fat, or they may have undergone cretefaction, calcification, etc. In precisely the same manner, also, are formed certain of those loose bodies, called sometimes "floating cartilages," which are occasionally met with in the knee-joint.

It is worthy of notice, in this connection, that it is no uncommon thing to meet with examples of serous and sero-mucous cysts, originating in the connective tissue, in various parts of the body, whose source cannot be traced to vascular nævi, yet which contain a sanguinolent fluid: indeed these connective tissue tumors sometimes furnish a troublesome hæmorrhage when they are simply laid open. In the multilocular varieties especially, there is often bleeding from the mouths of small vessels opening into the interior; and the adjacent tissues, also, have acquired sometimes an excessive vascularity, which has more than once, in my experience, rendered extirpation a bloody and hazardous operation.

Treatment.—Rest alone, in the recumbent posture, or rest with cool water lotions, cures speedily a certain number of recent acute cases of bursæ patellæ.

In the more chronic cases pressure made with a large sponge, wetted, and bound on tightly by a roller, while the limb is kept at rest, often succeeds. Blisters, the external application of tincture of iodine and other remedies of this class, have proved useful in the hands of others; but I have seldom or never seen any benefit from them when they have been employed under my own observation.

As surgical expedients I prefer, also, not to recommend injections, setons, subcutaneous incisions, or the small evacuating incisions practised by Mr. Brodie; all of which methods are slow, tedious and uncertain, while some of them must be regarded as extra-hazardous. Long, open incisions are very much to be preferred; the contents being allowed to escape freely, but not thrust out violently so as to irritate the sac. After incision, the limb should be placed completely at rest for a period of one or two weeks, and the wound dressed from the first, and for several days, with soft, warm fomentations or poultices. In case, at a later period, the sac does not granulate and close up, this result may be safely encouraged by injections of the tincture of iodine, or by other stimulants.

Excision is reserved for large and old bursæ, having very thick walls, or whose interiors have become solidified. If, after the walls of the sac are reached, the surgeon approaches carefully the base, keeping the edge of the knife directed toward the tumor, it may be dissected from the expanded tendon of the quadriceps and from the patella, without injury to either. After excision, any redundancy of integument having been removed by the knife, the edges of the flaps must be brought carefully together, and covered with a piece of lint spread with simple cerate; the limb ought then to be laid upon a well-fitting posterior splint of leather, secured by a few light turns of the roller enclosing the front of the knee and portions of the limb above and below. By this method I have more than once conducted these cases to a speedy and successful result.

Bursa over the Tubercle of the Tibia.—This variety of bursa is met with not unfrequently, yet far less frequently than bursæ patellæ. In January, 1865, at Bellevue Hospital, a remarkable example of this form of bursa upon both legs was brought to my notice, which had supervened upon chronic articular rheumatism twelve years before. One of these tumors I removed successfully by excision, but the patient, a female, refused to submit to an operation for the removal of the other. They were each about the size of a large orange, and were composed of a solid fibrous structure.

The treatment of these bursæ is the same as for bursæ patellæ.

Bursa under the Ligamentum Patellæ.—It seems proper in this connection to speak of a deep-seated bursa, usually found in adults underneath the ligamentum patellæ, extending from the upper margin of the tubercle to the top of the tibia, and which is occasionally enlarged. When distended by accumulations of fluid it presents itself conspicuously on each side of the ligament, but sometimes more distinctly upon one side than upon the other.

The point of most practical interest relating to this bursa is, that it sometimes communicates with the capsule of the knee-joint; and inasmuch as the fact of the existence of this communication cannot generally be determined, it will always be unsafe to open the bursa, or in any way to disturb its interior walls. Monro, in his excellent treatise on the bursæ, relates that in 1786 he had two of these cases, both of which he opened by a valvular incision. In one case the result was only palliative, and in the other suppuration of the knee-joint ensued and amputation became necessary. Many years ago I treated a bursa of this kind which occurred in a young man, and which had extended down upon the inside of the tibia one or two inches below the tubercle, by a seton made of a single thread of silk. Suppurative inflammation ensued, involving the knee-joint, which eventually caused the patient's death.

Olecranon Bursa.—Syn., Bursa Anconiæ; Miner's Elbow.—Bursæ anconiæ form over the olecranon process, chiefly in persons whose occupations require them to rest much upon the elbow; and they are, therefore, frequently met with among miners. The following example, however, constitutes an exception to this rule, the bursæ having formed without any apparent special provocation; it is also singular in being an example of symmetrical bursæ, occurring probably in obedience to the same law which governs symmetrical eruptions and some other diseases:—

A gentleman presented himself to Dr. Leonard, of Lockport, N. Y., in 1856, with a bursal tumor over his right elbow of the size of a pigeon's egg, and which had formed somewhat suddenly a few days before. No cause could be assigned; he was not accustomed to rest upon his elbow, and he had received no injury. Dr. Leonard opened the bursa freely and gave exit to about three drachms of ero-muculent fluid, and in a few days a complete cure was effected. The week following his dismissal he returned with a precisely similar tumor upon the opposite elbow, which was treated in the same manner as the first, and with the same result.

The same plans of treatment are applicable to these cases as have been indicated for patellar bursæ.

Bursæ in front of the Wrist and Palm of the Hand.—Beneath the anterior annular ligament are two distinct synovial sheaths, one of large size, embracing the tendons of the flexor sublimis and profundus, and one for the tendon of the flexor longus pollicis; the latter extending from above the wrist to near the extremity of the thumb. In like manner, the extensor tendons passing under the posterior annular ligament have elongated synovial sheaths, of which there are six, more or less separated from each other, and which extend from above the wrist to near the insertions of the tendons. All of these synovial sheaths are subject to considerable variation, both as to their extent and connections: in some cases the septa between adjacent sheaths are lost, and in other cases the sacs communicate by small openings. The *Palmar* sac or sacs are those which are especially prone to become enlarged, forming an oblong or a double tumor, one portion of which presents above the annular ligament, and the lower portion in the palm of the hand, or along the palmar surface of the thumb. These tumors are generally elastic, and in most cases the contents may, to some extent, be pushed from one portion of the tumor to the other. Pain, in consequence of the pressure, is a usual attendant, and the fingers are apt to become embarrassed in their movements, or contracted toward the palm of the hand. Suppuration has occurred spontaneously in some of the examples which have come under my notice, the final result of which has been a permanent contraction of the fingers. Small fibrinous bodies, like millet-seeds, are sometimes found in these and other similar synovial sacs, and also small cysts resembling hydatids; but in most cases they contain only a sero-muculent fluid, which, as in the case of the contents of the bursæ patellæ, yet much less frequently, is found stained with blood-corpuscles. The presence of the millet-seed bodies is generally indicated by a peculiar creaking sensation when the sac is pressed upon.

Treatment.—A variety of plans have been suggested and practised with more or less success by surgeons, including incision, excision, injections of iodine, acupuncture, blisters, etc. I am persuaded, however, that surgical interference is seldom proper, except it be to open the sac freely, whenever suppuration is imminent or has already taken place. Velpeau relates that in 1822 he saw Prof. Richerand, at the Hospital St. Louis, open a tumor of this kind in a healthy girl nineteen years old. The operation was performed with every necessary precaution, yet intolerable pain and violent inflammation ensued, resulting in abscesses, and she was not out of danger until after six weeks of suffering. He adds that he has seen the operation of incision, or of passing a seton through the tumor, followed by death in several instances at the Hôtel-Dieu. I have myself seen a patient succumb to spontaneous inflammation and suppuration of these bursæ;[1] and Mr. Tatum, in Holmes's Surgery, has reported a similar case.

A few examples, reported from time to time, of successful surgical interference, by either of the methods above referred to, will not alter the convictions of experienced operators. They will still hesitate to provoke inflammatory action in these sensitive surfaces, unnecessarily.

Long-continued and carefully-adjusted pressure has sometimes proved serviceable, by causing a gradual absorption of the effused fluid; and in one of the examples related to me the patient experienced much relief from a distressing burning pain by continued applications of cold water. In all cases the hand should be kept at rest as much as possible, and it should be especially protected against contusions, sprains, and other special causes of inflammation.

Bursæ in various other parts of the Body.—The frequency with which bursal enlargements occur in various parts of the body, and their liability to be mistaken for other forms of swellings and tumors, seem to render it proper that we should indicate with some precision the remaining anatomical points at which they are most often found. This enumeration seems to be the more necessary because a full catalogue of them can seldom be found either in the systematic treatises upon Surgery or Anatomy.

Erichsen speaks of a superficial bursa as occasionally seen upon the symphysis of the chin, and also of a bursa under the angle of the jaw. I have met with a bursal tumor formed within the synovial sheath which covers the tendon of the digastricus (see tumors of the neck). A natural bursa exists in the thyro-hyoid ligament, and an accidental bursa may form in front of the thyroid cartilage (see ante-laryngeal tumors). An accidental bursa has been seen over the acromion process. A natural bursa exists between the acromion process and coraco-acromial ligament on the one hand, and the capsule of the shoulder-joint on the other; between the point of the coracoid process and the capsule of the shoulder-joint—small, and sometimes wanting; between the under surface of the subscapularis and the neck of the scapula—generally communicating with the joint; between the same tendon and the capsule—small, and frequently communicating with the joint; between the conjoined tendon of the coraco-brachialis and short head of the biceps near its origin, and the capsule of the joint—not always present; within the sheath of the long head of the biceps; between the tendon of the teres major and the upper margin of the tendon of the latissimus dorsi and the humerus; between the tendon of the latissimus dorsi and the humerus—small; between the deltoid and the muscles inserted into the head of the humerus.

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[1] Eight examples of Bursæ of the Wrist, reported by the Author. *The Medical Record* 1870.

The bursa between the tendon of the latissimus dorsi and the inferior angle of the scapula is quite often found enlarged by increased synovial secretion. Velpeau, in his Operative Surgery, speaks of it also as the frequent seat of hæmatic tumors. In 1853 I met with a hæmatocele in this situation, in a girl ten years old, the tumor having then existed two or three years. As it was quite circumscribed, presenting itself of about the size of a hen's egg, I extirpated it with the knife. I then found it to be multilocular, the several cysts containing a bloody serum. In one case related by Velpeau, simple incision caused suppuration and eventually death. In Sept., 1858, I removed a fibrous tumor from a Mrs. H. of Warsaw, N. Y., which probably originated in this bursa.

There is a bursa between the tendinous insertion of the biceps and the tubercle of the radius,—usually containing a small pellet of fat; between the common origin of the extensor carpi radialis brevior and the extensor communis, on the one hand, and the head of the radius on the other; also between the olecranon process and the tendon of the triceps. (The superficial and accidental bursa over the olecranon process, called miner's elbow, has already been described.)

Bursæ are found occasionally over either condyle of the humerus. Congenital bursæ exist under the brachialis anticus. (The various bursal sacs in the neighborhood of the wrist were mentioned in connection with the bursal tumors forming in this region.)

Accidental bursæ form sometimes over the sternum in cabinet makers, occasioned by the pressure of instruments. They are occasionally met with over the spinous process of the seventh cervical vertebra; over the tuberosity of the ischium, between the skin and the aponeurotic lamina, and over the anterior superior spinous process of the ilium. I think I have also seen a suppurating bursa upon the coccyx.

In the region of the hip-joint bursæ are numerous; being generally found beneath the pectineus near its insertion into the femur; between the gluteus medius and the trochanter major; between the gluteus minimus and the trochanter major; between the gluteus maximus and the femur, below the trochanter major (two, one large and one small); between the obturator externus and the ischium; between the obturator internus, gemini and capsular ligament; beneath the conjoined origin of the semitendinosus and the long head of the biceps; and beneath the origin of the semimembranosus. One of the largest natural bursæ in the body, but which is seldom the seat of disease, is found between the conjoined tendons of the psoas magnus and iliacus internus on the one hand, and the capsule of the hip-joint on the other. This bursa generally communicates with the joint. A sub-tegumentary bursa is sometimes found over the trochanter major.

In the lower portion of the thigh, underneath the expanded tendon of the quadriceps, more or less of a bursal cavity will generally be found, which occasionally communicates with the joint. In Augu[illegible] 1855, a child six years old was brought to me with a very large bur[illegible] in this situation. Its limits below were very accurately defined, co[illegible]responding to a point near the upper wall of the capsule of the kn[illegible]e joint; above, it extended to within two or three inches of the t[illegible]o-chanters. The child was very feeble, and no surgical treatment [illegible]as advised.

A few years since, Dr. Vandeventer, of Roslyn, consulted me in relation to a lady under his charge, having a bursa in the same situation, which had existed eight years, its commencement dating from the period of the suspension of her menses. It was subsequently opened freely by Dr. Vandeventer, in pursuance of my advice, and discharged both pus and serum. After a time, also, it was observed that the interior of the sac had become partially lined with calcareous deposits.

In July, 1855, I was consulted by a young man on account of a bursa under the quadriceps, which upon exploration was found to contain only a sero-muculent fluid. Three days later, he having returned to his home, Dr. Lockwood, of Lockport, by my advice, opened it freely and gave exit to more than four ounces of fluid, of the same character as that which escaped through the exploring canula. Lint was introduced into the wound, and on the sixth day suppuration was well established, but it was observed, also, that the pus contained a large amount of fibrin. After a few days bloody serum and fibrinous clots began to escape. At length, a large mass filled the opening and protruded from it, resembling a partly-organized clot. Under these circumstances I was again requested to see the patient, and having removed the whole of the protruding structure with my hand and emptied the sac, the wound was again dressed; and, as no vessels seemed disposed to bleed after the operation was completed, very little fear was entertained that the tumor, if such it could be called, would return. I subsequently learned that it was speedily reproduced and that the patient soon after died, having survived the opening of the bursa only about three months.

A natural bursa exists between the biceps flexor femoris and the head of the fibula. A gentleman, æt. 32, consulted me in July, 1855, with an enlargement of this bursa. The tumor was of the size of an English walnut, tense, elastic, and painful after much walking. It was dispersed by rest and the application of tincture of iodine. A bursa may be found between the tendon of the semimembranosus and the internal lateral ligament of the knee-joint, which I have once found enlarged; and, also, another between the tendons of the semimembranosus and inner head of the gastrocnemius on the one hand, and the ligaments of the knee-joint, on the other. This last bursa sometimes encloses a second bursa, which communicates with the joint. Under the popliteus is a bursa, communicating with the joint, which is quite often enlarged, and has been mistaken sometimes for a popliteal aneurism. A bursa exists between the sartorius on the one hand and the tendons of the gracilis and semitendinosus, on the other. Monro says there is a bursa, also, between these three latter tendons and the front and inner part of the tibia.

Of the bursæ over the patella and under the ligamentum patellæ, I have already made especial mention. They occur sometimes also over the tubercle of the tibia, and over either condyle of the femur. Of the former of these I have met with several examples.

Velpeau has three times met with enlarged bursæ between the tendo-Achillis and the os calcis. They occur, also, under the os calcis; and quite often under the plantar aspects of the metatarso-phalangeal articulations of the great and little toes.

For the remaining bursæ situated in the vicinity of the ankle, the tarsal, and phalangeal articulations of the toes, the reader is referred to the various treatises upon anatomy and especially to the great work entitled "Description of all the Bursæ of the Human Body," by Alexander Monro, Secundus, published at Edinburgh in 1788. Monro, however, only found bursæ in the extremities. As far as possible we have endeavored to supply his omissions.

Ganglion, R. C.; Syn., Weeping Sinew.—A ganglion may be described as one variety of bursa, consisting of a serous or synovial sac, usually of moderate dimensions, situated between the layers of a sheath enclosing a tendon, and, in a few examples, communicating by a small orifice with the interior of the tendinous sheath. Its most frequent seat is upon the back or front of the wrist, or upon the top of the foot. These tumors, unlike other bursæ, do not appear ever to arise from continuous pressure, or from the motion of the parts upon each other, but they originate most often from sprains. They form small, oval or round, colorless, firm but elastic swellings, varying in size from a pea to a small hen's egg, and which are observed to move with the sheath of the tendon to which they are attached. Their contents are usually a glairy fluid, resembling the white of an egg, being of a lighter color and more consistent than that which is usually found in other synovial or bursal sacs.

Treatment.—A ganglion is occasionally known to disappear spontaneously, but in that case it usually returns sooner or later. Firm and continuous pressure will sometimes effect a cure; or a more speedy dispersion of the swelling may be effected by a subcutaneous incision of the sac, the subsequent accumulation of the fluid being prevented by pressure; but the method generally preferred, as being on the whole most certain to accomplish a permanent cure, is to rupture the sac by a smart blow, made with a flat stick, or with the back of a book, after which they seldom become refilled. A few surgeons have ventured to practise and to recommend, in the treatment of these cases, free incisions, injections and excision; in relation to which methods the same remarks are applicable as have been made when considering in general, more fluid than those of younger growth; the contents are then said to be meliceroas, or honey-like. The process of fluidification is also more rapid toward the most projecting point of the surface than in other directions. Occasionally they contain one or more aborted hairs, which are, no doubt, successive growths from the remnant of the hair follicle.

Treatment.—Sometimes the sac becomes inflamed, and suppurates, resulting in a spontaneous discharge of the contents, and perhaps in a complete cure; or it opens at its apex, by absorption of the integument from pressure of the contents, without the intervention of suppuration.

Most patients find so little inconvenience from the presence of these tumors, that they will not consent to their removal. If, however, for any reason, it may be thought desirable to get rid of them, the knife is the only proper resort. An incision should be made carefully down to the sac, and, if possible, its removal should be effected entire. To facilitate this somewhat delicate operation, the surgeon is recommended to make his first incision upon one side of the tumor, and not directly across the top, where the sac is in general the thinnest; or, in case the excess of integument will warrant it, to make a double elliptical incision, leaving the central portion attached to the tumor.

If the cyst is accidentally opened, the contents should be at once thoroughly expressed, and the sac torn out by the forceps; taking care not to leave any portion behind, since its presence may retard the cicatrization, and possibly lead to the formation of another tumor. I must say, however, that notwithstanding there is a very general opinion entertained by surgeons that the smallest remnant of the sac is sufficient, in most cases, to cause a reproduction of the tumor in some form—such a result has never happened more than once under my observation, although in many cases I have not felt absolutely certain that I had removed all of the sac.

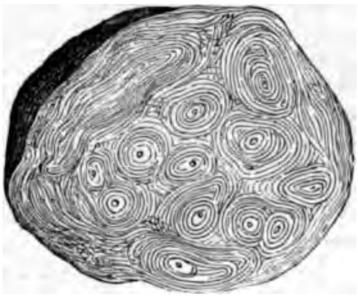
When these operations are made upon the scalp, the edges of the wound should be laid gently together; and after covering them with a piece of sheet lint, spread with simple cerate, the whole should be retained in place by a few light turns of a roller. Neither sutures nor adhesive plaster are in general advisable, on account of the dangers of erysipelas.

Those remaining tumors of this class, which limit themselves to particular organs, will be considered more appropriately in connection with the various regions and structures of the body in which they can alone occur. Among those which are thus reserved will be found, obstructions of the Meibomian glands; ranula, or obstruction of the ducts of the submaxillary and sublingual glands; obstructions of the duct of Steno; of the labial, buccal, lingual, and pharyngeal gland ducts; of the lacteal and seminiferous ducts; also certain encysted tumors of the thyroid gland, liver, ovary, uterus, and vagina.

ıtaneons areolar tissue, upon the periosteum; and especially are
›le to grow from the periosteum of the antrum and nares, form-
fleshy antral and nasal polypi; they are often met with in the
:, in the uterus, and in the testes.

ımata are composed of very tough, and generally firmly inter-
›rous tissue, arranged in wavy
, or in concentric layers around
axes; which latter, according
›th, is the result of the fibrous
›n taking place around nerves
sels. A certain number of
:tly developed cells and nu-
also generally found scattered
their substance.

Fig. 239.

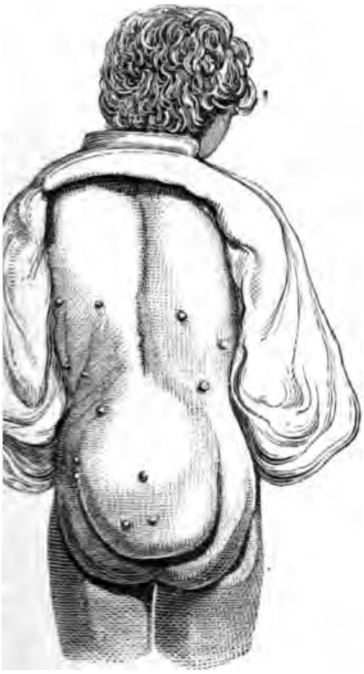


Section of a small Fibroma of the Uterus: Natural size.

fibromata generally grow slow-
hey are capable of attaining a
:at size. They present usu-
mooth, hard, but often nodu-
ırface, without discoloration,
; are seldom painful unless rendered so by pressure upon, or
ion of a nerve.

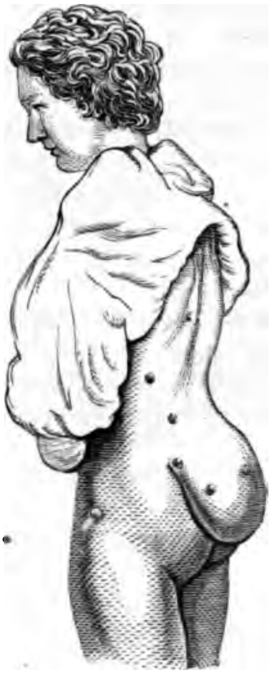
: example represented in the accompanying wood-cuts (figs. 238,

Fig. 240.



ma of the Back, with numerous small Fibromata.

Fig. 241.



Side View of same.

239), the large, original tumor was congenital, being first observed soon after birth, as a small elevation over one of the lumbar vertebræ. When removed by me, in 1871, and when the patient was about 25 years old, it had attained so great a size as to cause much inconvenience. During the year preceding its removal, also, a large number of smaller fibromata had appeared on various portions of the body. The removal of the original fibroma was effected safely by the knife.

Fibromata are not in all cases composed of a single element. Either originally, or by subsequent progressive or retrogressive changes, they are found to assume such a variety of forms and of combinations as to render it necessary that we should recognize numerous subdivisions. Thus, for example, under the general title of Fibrous Tumor are included *fibro-cellular*, *fibro-muscular*, *fibro-mucous*, *fibro-plastic*, *fibro-neuroma*, *fibro-adipose*, *fibro-cartilaginous*, *fibro-calcareous*, *fibro-osseous*, *and fibro-cystic.*

I shall give special consideration only to those examples in which the histological differences seem to possess some important clinical significance.

Fibro-cellular Fibroma. Syn., Tumor Fibro-cellulosus, R. C. Cellulo-fibrous Tumor, of Muller; Connective Tissue Tumor, of Vogel; Gelatinous Sarcoma, of Rokitansky; Soft Fibroma, of Billroth.—Fibro-cellular fibromata occur especially in the nares, in the form of the so-called "soft polypi," and in the scrotum and labia as "elephantiasis." They grow more rapidly than pure fibromata, and have a more elastic feel. On removal, they are found to contain a quantity of sero-plastic fluid, infiltrated throughout their structure, which can be readily pressed out from the fresh section.

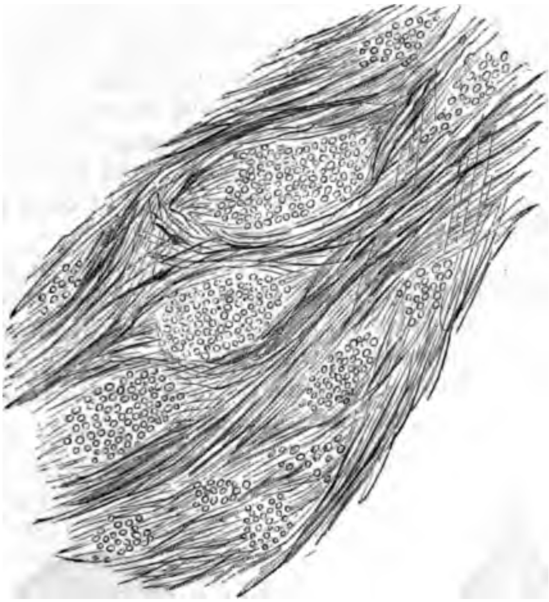
Billroth observes that these tumors, as they occur in the mucous membrane of the nose, rectum, and other portions of the large intestine, generally consist, to a great extent, of elevated and newly formed glands of the mucous membrane, whose closed ends sometimes dilate to mucous cysts. Hence, according to their anatomical situation and the glands they contain, they may be classed, he thinks, as varieties of the *adenomata.*

In children the soft polypi are almost limited to the rectum and large intestines; from puberty to about the thirtieth year of life they are more frequently met with in the nares; and about the age of thirty they are, in females, most often found in the mucous membrane of the uterus.

Treatment.—Excision, or thorough evulsion is generally successful; and no other plans of treatment are ordinarily worthy of a trial.

Fibro-myoma.—Among the more solid forms of fibromata there are some, which under the microscope present a fine areolar stroma, composed of undulating and interlacing fibrous bands, in the midst of which are numerous nuclei, and more or less elongated fibre cells Virchow considers these elongated and spindle-shaped cells to be muscle cells, and would therefore arrange such tumors as contain these elements under the *myomata*, or the *fibro-myomata.*

Fig. 242.



Fibro-myoma of the Uterus. 350 diameters.

These tumors, like pure fibromata, are generally benign in their character, and do not return after thorough removal.

Fibro-mucous Tumor. Syn., Mucous Tumor, or Myxoma, of Virchow.—This, also, is a variety of the fibro-cellular tumor, but in which the connective tissue is extremely delicate, so that it resembles the connective tissue of the vitreous humor, and of the fœtus *in embryo*, or of the Whartonian jelly of the umbilical cord.

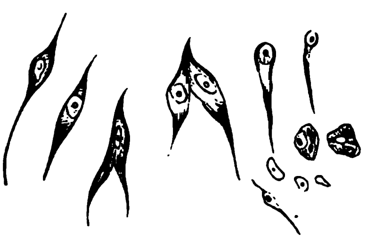
The fresh incision presents a yellowish, opalescent, jelly-like surface; and under the microscope are seen rounded, oval, elongated or branched corpuscles, with a finely fibrillated connective tissue.

Externally, they usually present a somewhat irregular surface; the integument is frequently discolored; they are more or less soft, or elastic under digital pressure, and they may increase rapidly and finally attain a great size; or they may ulcerate and bleed, or considerable portions may disintegrate and slough away.

Myxomata have a greater tendency to return after thorough removal than fibromata. They may be, therefore, classed as "recurrent."

Fibro-plastic Tumor. Syn., Tumor Fibro-plasticus, R. C.—These tumors resemble most other fibroids in their external forms, in their situation, and progress of development. They are seldom recognized, therefore, except by their tendency to return when extirpated, and finally, in most cases, by their disposition to assume a malignant or carcinomatous character. They are often associated with myeloid growths. Under the microscope they, also, are found to differ from other fibromata, in that they consist almost exclusively of elongated, fusiform cells, containing usually a single oval or oat-shaped nucleus and nucleolus.

Fig. 243.

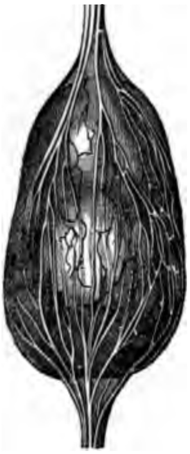


Fibro-plastic Cells.

Treatment.—They must be treated like all other recurrent and malignant growths, by early and thorough extirpation.

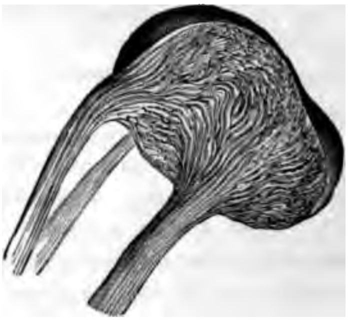
Fibro-neuroma, R. C.—Until recently all tumors occurring upon nerves were termed neuromata; but examples of true neuromata, in which the nerve filaments themselves have suffered enlargement, or in which new nerve filaments have formed, are rare. In most cases the tumor consists of connective tissue fibres distributed among the nerve filaments.

Fig. 244.



Fibro-neuroma.

Fig. 245.



Section of a Neuroma, connected with three nervous trunks.

These tumors occur sometimes without apparent provocation upon any point of the cerebro-spinal nerves. The nerves of the special senses are, however, rarely affected, and the nerves of the ganglionic system still more rarely. Their most usual seat is upon some of the peripheral nerves, especially of the lower extremities; and, when situated in the superficial areolar tissue, they are known as *painful subcutaneous tubercles.* These latter rarely attain a greater size than a hazel-nut, and in no case which has come under my notice was the tumor larger than a pea or a bean. They are hard, tense and movable, except when they have attached themselves to the superincumbent skin; the skin is ldom discolored, but occasionally it presents a shining, vascular and borescent appearance. They are exquisitely sensitive and generally ibject to severe, lancinating, paroxysmal pains. In December, 1844, removed a painful tubercle from the integument over the back of the oulder, in the case of a gentleman 26 years of age, which had been rowing nine months. It was of the size of a bean, hard, irregular pon the surface, exquisitely sensitive, and the skin over the tumor id assumed a brownish color. The three remaining examples which ive been observed by me were upon the legs, one being presented in girl æt. 25, the second in a man aged about 30, and the third in a ntleman aged about 50. In the last-mentioned example there were ro tubercles separated from each other by a space of two or three ches; they were not larger than small shot, and, on being touched, e pain was so intense as to cause a sensation of faintness.

Traumatic Fibro-neuromata are quite frequently found upon the ids of divided nerves, forming at the point of division a bulbous ilargement which can be distinctly felt, and is exquisitely sensitive to ie touch.

Treatment of Fibro-neuromata.—Spontaneous peripheral fibro-euromata, in the form of the painful subcutaneous tubercle, seldom cur after removal; at least I may say that in the four or five amples of this form of tumor which have come under my notice, cision has proved a prompt and successful remedy; but in the aumatic variety, my experience has been less gratifying. In a ajority of cases excision of the extremity of the nerve has been ollowed sooner or later by a return of the disease in the divided xtremity; and this has happened, sometimes, when considerable ortions of the affected nerves have been excised, and after repeated -amputations. It seems quite probable that the gradual propagation a chronic neuritis along the nervous trunks, and the general nervous isturbance occasioned by the delay in operating, have been the cause this predisposition to return, and that it would be advisable in all ses to operate early, or as soon as the existence of the neuromatous fection is fully determined.

Glioma (Virchow).—Virchow defines a glioma as a soft vascular mor, originating in the neuroglia, the delicate interstitial connective sue of nerve. It is a malignant growth, and has heretofore not en distinguished from encephaloid, to which its clinical history actly corresponds. The retina, during the periods of infancy and rly childhood, is the favorite seat of this affection.

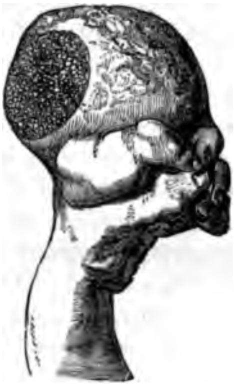
I have placed this tumor in connection with fibro-neuroma, because rchow has restricted the term glioma to tumors originating in the uroglia. With equal propriety, in an anatomical point of view, it ght be classified with the fibro-cellular growths; but, in our opinion, re properly still it must continue to occupy its original position as a form of encephaloma of the adjacent areolar tissue. In most cases the fat cells contain crystals of the fatty acids, and especially margaric acid.

Adipose tumors seldom or never assume a malignant character, nor are they disposed to return when thoroughly excised. Their excision is generally accomplished with great ease. If the surgeon takes care to divide the integument freely over the tumor, exposing fairly to view the yellow adipose tissue, and cutting the fibrillated bands which penetrate a little between the lobules, the whole mass may, in most cases, be removed by evulsion. By adopting this method, also, the bleeding is usually less than when the removal is effected by the knife alone; the operation can be made more quickly, and a closure of the wound by adhesion is more apt to occur.

Cartilaginous Tumor.—Syn., Tumor Cartilaginosus; R. C.; Chondroma; Enchondroma.

Cartilaginous tumors may occur in almost any part of the body, either n the soft or hard tissues, but they are most commonly met with in onnection with the bones, and especially upon the phalanges of the hand and the metacarpal bones, in children. The corresponding bones of the feet are also quite subject to enchondromata; the femur, scapula, and pelvic bones occasionally present enormous tumors of this class; upon the bones of the head and face they are less frequent. The most frequent seats of cartilaginous deposits in the soft parts are, the salivary glands, the testicles, the ovaries and the mammæ; in which cases it may be found forming the whole or only a portion of the morbid structures, being generally associated with fibroma or carcinoma.

Fig. 248.



Section of an Enchondroma.

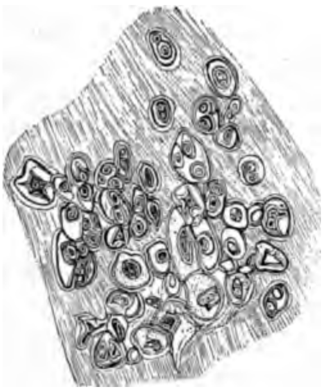
Cartilaginous tumors occasionally cease to grow, especially under improved conditions of the general system. This arrest of growth sometimes takes place without change of structure, but in most cases not until portions of the tumor have undergone ossification.

As in fibroma, adenoma and carcinoma, so also, in enchondroma, the connective tissue may become gelatinous; in consequence of which certain portions may, to the naked eye, resemble colloid. The central portions, also, are often seen to degenerate into a thin yellowish fluid, resembling synovia or honey, forming cysts or cavities of various sizes, the degeneration involving sometimes the entire mass, and leaving only a thin fibro-cellular cystic envelope. It is possible that in both of the preceding conditions, we ought to recognize incomplete or arrested development of cartilage and connective-tissue cells, rather than degeneration of pre-existing cartilage cells.

Cartilaginous tumors may also undergo fatty and calcareous degeneration, or the interior may suppurate or slough.

When enchondroma commences from the interior of the bone, the external surface assumes generally an oblong, oval, or fusiform shape; but when, as is most often the case with long bones, it originates from the outer wall, the form is more irregular, usually nodular. These tumors are generally elastic, sometimes yielding under pressure, with a slight creaking sensation.

Fig. 249.



Cartilage cells, 290 diameters. Arnold.

Enchondromata cannot in themselves be regarded as malignant; nor indeed does the presence of a considerable amount of fibrous stroma vary essentially the prognosis. Those alone which are associated with carcinoma in some of its various forms are very liable to return, or to multiply themselves by infection, in other parts of the body.

Histological Elements.—A network of filamentous tissue existing in a greater or less degree constitutes the basis, or stroma, within which the cartilage cells are found, resting in a hyaline substance. The cells present the greatest variety both in form and size. They may contain from one to twenty nuclei. Chemically, an enchondroma consists chiefly of the phosphate of lime, and of a peculiar variety of gelatine called chondrine.

Treatment.—The occasional spontaneous arrest of these growths, as age advances, or as the general condition of the system improves, suggests the propriety of the employment of hygienic and therapeutical measures; and while I am unable to indicate any specific plan of treatment which could be regarded as applicable to all cases, nevertheless I am convinced that I have occasionally seen these growths, especially, when occurring in early life, upon the fingers, and upon the lower epiphysis of the radius, delayed and finally arrested, by air, exercise, nutritious food and tonics.

When such measures have failed, and the tumors are formed between the periosteum and the bone, as happens pretty often in connection with the epiphysis of the knee-joint, excision may be safely practised in a certain number of cases; and the operation is rendered the more safe in such cases by the fact that the articular surfaces are seldom involved. It must be remembered, however, that these eccentric enchondromata generally cause absorption of the outer wall of the bone, and that the tumor will be found usually more or less embedded in the cancellous structure.

Free incisions, or the removal of portions of the projecting walls, d by injections, have occasionally succeeded when the enchon- has assumed a cystic character.

her cases, the treatment must be either expectant, or the grave tives of excision or amputation have to be considered. After ;h excision these tumors seldom return.

Bony Tumor.—Syn., Tumor Osseous, R. C.; Osteoma.

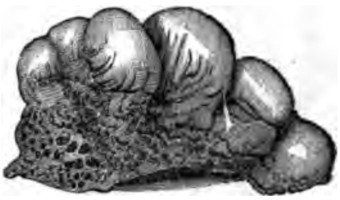
osteomata are not of so frequent occurrence as are tumors con- bone, and possessing, therefore, a mixed character, such, for e, as osteo-chondroma, osteo-fibroma, osteo-carcinoma, osteo- l, etc. We propose in this place to consider only the true bony ; which occur chiefly as exostoses, but which are occasionally ›ed within original bony structure, and still more rarely as inde- t formations, having no connection with any part of the bony 1.

itosis.—Of the exostoses, or bony outgrowths, there are three s, namely, the spongy, the hard, and the eburnated or ivory-

ıe *spongy* variety occurs almost exclusively upon the epiphyses of ; bones as an outgrowth from an epiphyseal cartilage, with a thin f which it is usually enclosed; and for this reason it has been ›y Virchow *ecchondrosis ossificans*. These tumors resemble in ·e the cancellous or medullary portions of bones. They present ıves as smooth, hard, globular, nodulated or spinous projections; ; in most cases very slowly, unaccompanied usually with pain, ıess, or discoloration of the skin.

are seen most frequently upon the tibia, fibula and humerus, and ın only occur in children, or at ›eriod preceding the complete tion of the epiphyseal cartilages.

Fig. 250.



Exostosis from upper extremity of humerus. Lister.

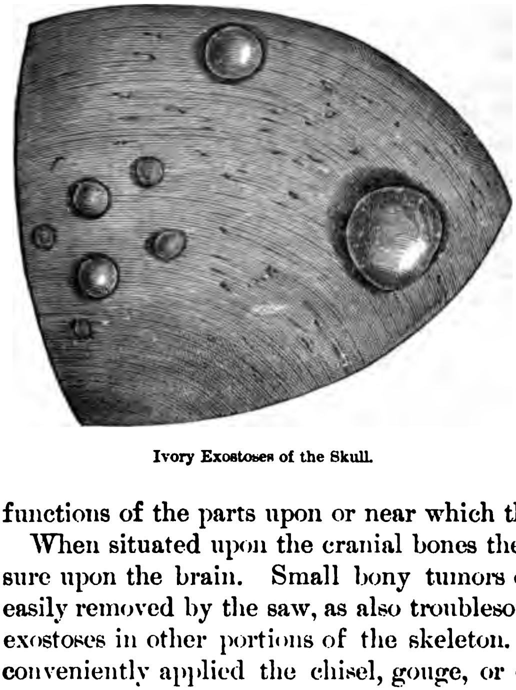
ıe *hard* exostoses, resembling in ects the lamellated tissue of nat- ›ne, are more often spinous in ccurring usually at the points of ıents of muscles, and must be re- in most cases as examples of hypertrophy of natural spines ›cesses. They are met with, also, 'requently, upon portions of the skeleton which are subjected to ressure and attrition.

burnated, or ivory-like, exostoses, are relatively unfrequent. ·e met with most often upon the inner or outer surface of the cra- ılt, originating sometimes, also, in the diploic structure or in the sinus, and from thence making their way inwards or outwards. ·e found growing from the orbital plates, from the antrum and other portions of the superior maxillæ, rarely upon the inferior maxilla, the roots of the teeth, the scapula, pelvis, and other flat bones. Quite frequently, however, an ivory-like exostosis proceeds from the distal extremity of the last phalanx of the great toe, and, according to Paget, its most usual seat is upon the inner margin, directly underneath the incurvated edge of the nail.

Eburnated exostoses of the outer plate of the skull generally cease to grow when they have attained about half an inch in diameter. The same class of tumors upon the great toe are usually arrested spontaneously at a still earlier stage of their growth, while in other situations named there seems to be no fixed limit to the process of growth and development.

It is proper to mention that the process of eburnation is sometimes incomplete, certain portions of the tumor still presenting a cancellated structure.

Fig. 251.



Ivory Exostoses of the Skull.

Ivory-like exostoses exhibit Haversian canals, lacunæ and lamellar systems. They differ therefore from ordinary bone only in being more compact, in possessing less animal matter, and in containing more of the phosphates and less of the carbonates.

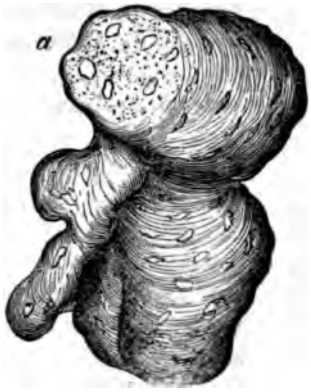
Treatment of Exostoses.—Exostoses are essentially benign in their character, and, therefore, never demand removal unless they cause deformity or interfere with the natural functions of the parts upon or near which they are situated.

When situated upon the cranial bones they may cause death by pressure upon the brain. Small bony tumors of the skull are sometimes easily removed by the saw, as also troublesome spinous or pedunculated exostoses in other portions of the skeleton. Where the saw cannot be conveniently applied the chisel, gouge, or cutting pliers will often be used with advantage. I have removed them in this way, and I have observed that, even when the tumor has not been thoroughly extirpated, it has never manifested a tendency to return. Exostoses of the orbit cannot usually be extirpated safely, and it has been advised, when they seem to threaten death from cerebral pressure, to expose the surface by a removal of the periosteum, and apply the actual cautery, nitric acid, or potassa fusa, so as to induce necrosis.

When occurring in either of the maxillæ they can be removed with assurance of success.

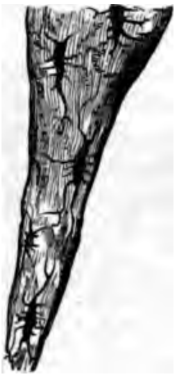
Osteomata of the Soft Tissues, independent of the bony structure, occur, as has already been stated, in various parts of the body, especially in the tendons and muscles; but they seldom impair the functions of the organs implicated, and, therefore, do not often demand surgical interference.

Fig. 252.



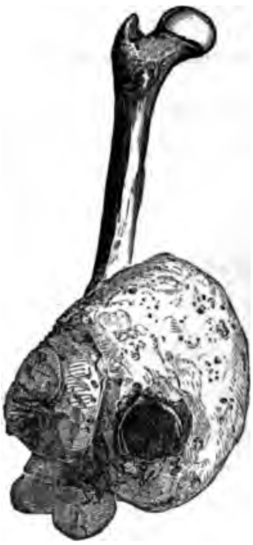
Bony Tumor from Arachnoid Membrane of Spinal Cord. *a* represents a section. Wedl.

Fig. 253.



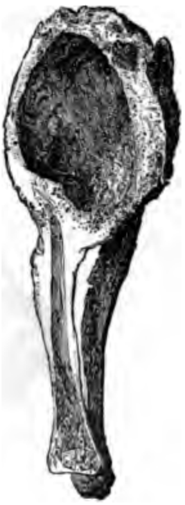
Bony Growth from Choroid Membrane. Magnified. Kirk.

Fig. 254.



Cystic Osteoma of Femur.

Fig. 255.



Cystic Osteoma of Tibia.

Cystic Tumors of Bone.—These tumors form in various portions of the skeleton, but most frequently in the upper or lower jaw, or in the lower end of the femur.

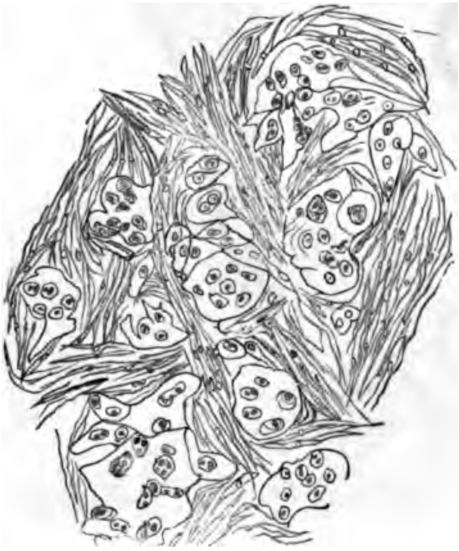
They may be unilocular or multilocular; the interior may be occupied by fluid or solid materials. When the tumor is composed of a bony shell, filled with a solid fibrous or fibro-plastic substance, it answers to the tumor called by the older surgeons *osteo-sarcoma*; and when the contents of he cyst (*cystic osteoma*) are luid it corresponds to the *pina ventosa* of the early riters.

Treatment. — Bony cysts ontaining fluid may someimes be destroyed by free ncision, followed by injections, and the subsequent suppuration of the interior cavity. I have in this manner succeeded in removing two situated upon the lower jaw. In other cases it may be found necessary to remove the whole or a large portion of the external wall. Solid tumors of this class (osteo-sarcoma) must be removed entire, either by enucleation, excision, or amputation.

Myeloid Tumor of Bone.—Syn., Tumor Myelodes Ossis, R. C.; Central Osteo-sarcoma of Billroth; **Myelo-plaxic,** of **Lebert.**

The Myeloid Tumor of Paget originates generally from bone. It consists of large vesicular or plate-like cells, measuring from $\frac{1}{300}$ to $\frac{1}{1000}$ of an inch in diameter, and containing each from two to twelve oval nuclei, with nucleoli: in which characters they resemble the cell structure of the fœtal marrow. The cell structure is very abundant, while the intercellular substance is relatively much less than in other fibroids. The latter is sometimes scarcely to be recognized, being represented by a soft gelatinous or colloid substance.

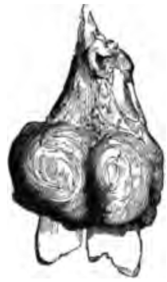
Fig. 256.



Myeloid Tumor, 200 diameters. Arnold.

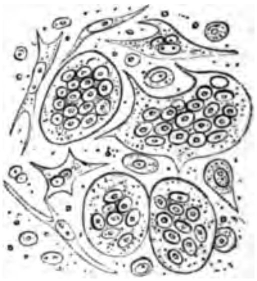
The myeloid tumors are especially prone to originate in the shafts of the tibia, radius and ulna, and still more frequently they are met with in the lower jaw. They often contain mucous cysts, or the interior may be occupied by osseous formations of an arborescent or spherical form. When they occur in the lower extremities they become very vascular, and present frequently a distinct *bruit*, so that they have been mistaken for aneurisms.

Fig. 257.



Epulis.

Fig. 258.



Myeloid Cells from same.

The fibro-plastic and the myeloid tumors are often associated; and it is especially observed that the myeloid structure is prone to increase and displace the fibro-plastic elements as the tumor progresses, or in its successive recurrences after removal. For this reason, and with propriety, the two forms have of late been arranged under a common name, and are designated by some writers as fibro-plastic and by others as myeloid. Occupying an intermediate position between the benign and malignant growths, and being very liable to return after complete removal, they might properly be classified with the "recurrent" tumors.

Vascular Tumor.—Syn., Tumor Vasculosus, R. C.; Angioma of Billroth; Erectile Tumor.

Vascular tumors present themselves under various forms, according as the arterial, venous or capillary systems of vessels are chiefly implicated.

Aneurism by Anastomosis.—Syn. Racemose Aneurism.—Those vascular tumors which consist of expanded, elongated, and tortuous arterial trunks and arterioles, including sometimes the venous capillaries and larger venous trunks, are termed "aneurisms by anastomosis." They occur in all parts of the body which are supplied with blood-vessels, both in the soft tissues and bones; but most frequently upon the scalp, in the orbits, upon the face and lips. Their most frequent seat in the bones is the head of the tibia. They form bluish, soft, elastic, and more or less compressible tumors, which generally pulsate distinctly, the pulsation being accompanied with a peculiar whiz, thrill, or purring sensation, unlike the bruit of an aneurism. Long-continued pressure will generally sensibly diminish the size of the tumor. They occur most often in early adult life, but I have seen them not unfrequently in infancy and childhood.

Cirsoid Aneurism is the name applied to the same condition when the dilatation and elongation is limited to the arterial trunks.

Treatment.—Destruction with hot needles, injection with the persulphate of iron, compression, electrolysis, the ligature, and the knife, are the surgical remedies most commonly resorted to in cases of aneurism by anastomosis. The choice of expedients depends very much upon the circumstances of the case, and must therefore be left to the judgment of the surgeon. My own experience is limited to electrolysis, the ligature and the knife; to the one or the other of which I think, in general, the preference ought to be given. In the case of very large tumors of this class it sometimes becomes necessary to ligate the main arterial trunk supplying the tumor, as preliminary to more direct surgical interference.

The cirsoid aneurism is seldom cured unless it is subjected to treatment at a very early period. In a few examples, however, a careful and persevering application of ligatures has accomplished a cure when they had already attained a considerable size. (See Aneurisms.)

Venous or Cavernous Nævi are not unfrequently congenital, as they present themselves soon after birth; they constitute, therefore, one variety of the so-called "mother's mark." They are met with most frequently beneath the mucous membrane of the lips, and in the subcutaneous areolar tissue of the face, as small tumors of a rounded form, and of a purple or reddish-purple color. They are compressible, elastic, and can be partially evacuated by pressure; but they do not pulsate, nor is the entrance of the blood accompanied with any kind of bruit; the external boundary is generally not very distinctly defined, but in some cases they are invested with a thin capsule, which gives to them a more accurate limitation. This variety of vascular growth is also frequently associated with that next to be described.

Treatment.—Venous nævi, if not large, can usually be removed by the knife, unless situated upon or in the vicinity of important blood-vessels, or other structures which might render the operation hazardous. When encapsulated, the hæmorrhage, consequent upon excision, is usually very slight. In other cases we employ the ligature, or the galvano-cautery. Injections of the persulphate of iron, made for the purpose of securing coagulation of the blood, have in several instances caused death, and can no longer be considered safe. In those cases in which death has been caused by injection, it has been thought that a clot may have become displaced and have entered the circulation; but inasmuch as no similar accidents have been reported after coagulation by electrolysis, it is to be presumed that death was caused by the admission into the circulation of the material employed in the injection. Venous nævi are destroyed sometimes by pressure, effected by collodion plaster, by cauterization with hot needles, or by vaccination. I have seen them made to slough by the application of nitric acid, and occasionally they slough and disappear spontaneously.

Capillary Hypertrophy or **Ectasy** constitutes the most frequent form of vascular growths; and it is to this variety that the terms *telangeictasis*, *nævus* and *mother's mark* are most commonly and most appropriately applied.

They are usually congenital and sometimes hereditary; occurring most often upon the face and neck. They are composed almost entirely of tortuous and dilated capillaries, involving only the cutis; consequently the surface is often but slightly, if at all, elevated. They are of a bright red color, and vary in size from a pin's head to several inches in diameter.

As has already been stated, they are frequently associated with the venous angiomata, and in these cases the surface is elevated, and many examples present a variegated or mottled blue-and-red appearance.

The capillary or plexiform variety of nævi, unassociated with the venous, when very small, or very indistinct at birth, often disappears spontaneously; in most cases, however, they remain of the same size or gradually spread. The mixed varieties, previously described, invariably increase gradually, yet, in some cases, slowly, and sometimes after the lapse of many years they attain a very great size.

Treatment.—In the most superficial form, no interference is necessary or proper unless it occurs upon the face or neck, where its presence sometimes causes a serious deformity. Nor upon these portions of the body is it proper to attempt its extirpation when it covers a large extent of surface; certainly not by any of those measures which must necessarily cause cicatrices and tegumentary contractions. If it is limited, however, it may be removed by excision, or by the ligature. In superficial nævi of the extent of one or two inches, in the neighborhood of the eyelids, where the removal of the integument must have caused eversion of the lids, I have succeeded completely by dissecting up all of the affected integument, removing the subcutaneous areolar tissue, and then replacing the skin in its original position. This method is even more appropriate when the venous variety of nævus is distinctly associated with the capillary; but experience has shown that it may succeed even when, as in the variety now under consideration, the subcutaneous veins or arteries give no indications that they are also involved.

Dr. Maas, of Breslau, has collected, in the *Archiv für Clinische Chirurgie*, the histories of 112 cases of nævus treated by the galvano-cautery. The results were as follows:—

Capillary nævus, cured, 32; improved, 1; result unknown, 1. *Cavernous or venous nævus*, cured, 72; improved, 1; result unknown, 1; died, 3. *Arterial or racemose nævus*, cured, 2; improved, 1. *Nævus combined with other tumors*, cured, 6; improved, 1; result unknown, 2. He derives from examination of these cases the conclusion that the galvano-cautery is followed by the best results in nævus, and is much safer than the injection of perchloride of iron, or any other coagulating fluid.

Moles exhibit also something of that capillary and plexiform vascularity which belongs to capillary angioma, but their essential characteristics are due to a tegumentary hyperplasy, and to the presence of an unusual amount of pigment. It is well to remember, however, that moles, like angiomata and warts, possess that kind of ectasy of structure which every now and then, especially in advanced life, renders them the seat of malignant growths. For this reason their early extirpation by the knife can always properly be recommended.

Tumors of Lymphatic Glands.

Scrofulous Enlargements of the Lymphatic Glands. Syn., Scrofulous Sarcoma of Langenbeck; **Lymphomata** of Billroth. These enlargements are observed most frequently in the glands of the neck; but all the absorbent glands are liable to similar hyperplasiæ.

Usually several glands are affected simultaneously or consecutively. The period of life most favorable for the development of these tumors is between the tenth and twentieth years.

Lymphomata sometimes undergo a gradual softening and degeneration, and terminate in ulceration, with or without suppuration, leaving irregular and unhealthy lines of ulceration; and when at length these ulcerations have healed, an unsightly nodular cicatrix remains. In other cases they continue to enlarge, and finally, in exceptional cases, they may coalesce, forming one large bosselated mass, occupying the whole side and front of the neck.

According to the latest observations, these tumors are composed almost wholly of lymph-cells, nothing being left of the original structure but a fine network of connective tissue forming their capsules and trabeculæ, and the blood-vessels; the walls of the latter being greatly thickened.

When they rapidly increase in size, and form agglomerated masses, we may apprehend a malignant tendency, the lymph-cells becoming at first extensively infiltrated into the adjacent tissues. These *malignant* lymphomata, called by Lücke *lympho-sarcomata*, have been seen by me most frequently in adults, or after the eighteenth or twentieth years of life, and I have recently met with a case in a lady sixty years of age. Billroth observes, however, that lymphoma is the more dangerous the younger the patient.

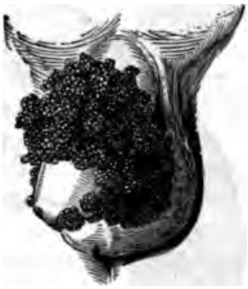
Treatment.—Iodine in some of its forms will be found the most effective remedy for this condition in the earlier stages and when the tumors are not very numerous or aggregated in masses: animal food, with pure air and tonics, constitute, also, valuable adjuvants; but when the growths assume very decidedly the character of lympho-sarcoma, iodine is in most cases ineffective. Billroth, in 1871, first observed that malignant lympho-sarcoma was sometimes cured by arsenic. Several other writers have confirmed this observation, and in 1881 I saw in the case of an old gentleman who consulted me, an enormous lympho-sarcoma of the neck disappear in a few weeks under the use of arsenic. A few surgeons have not only given the arsenic internally, but they have injected the tumors with the same; but the latter process has sometimes rather increased the activity of the malady. In my own case I employed Fowler's solution in doses varying from three to ten drops three times daily. Extirpation, which I have occasionally practised to prevent suffocation, has been in all cases followed by a speedy return of the same or of a more malignant form of the neoplasm in the wound, or by the speedy enlargement of other glands in the neighborhood. Nor can I speak much more encouragingly of excision as a remedy for the slower and more purely scrofulous growths, since in most cases, after the most thorough extirpation, new glandular enlargements have soon been presented.

Simple Glandular Hypertrophy. Syn., Hypertrophia Glandularum, R. C.; Adenoma, Billroth. Simple hypertrophy of gland textures may occur wherever these structures exist. It may be benign in charıay be associated with malignant neoplasms. Hypertrophied ıre, originally benign, may become malignant by infiltration ells: such transitions are, however, exceptional. The most ;amples are seen in bronchocele, hypertrophy of the mam- c mammary tumor), enlarged prostate, and in examples of argement of single lymphatic glands.

Dermata and Epidermata.

ırm Growths, or Hypertrophy of the Papillæ. Syn., ta.—These growths occur upon mucous membranes—espe- se points where mucous structures are about to terminate in y, in the glands, and wherever epithelium is found. They h especially in the larynx, at the angles of the mouth, upon lips, in the external auditory canal, at the verge of the anus, lans penis, about the meatus urinarius of the female, upon agina and os tincæ. When occurring upon mucous mem- are usually soft and highly vascular, like cock's-combs, each pilla assuming generally a leaf-like or tuberose form; when ıber of adjoining papillæ are hyper- ıe surface often presents a granular, and is separated by vertical fissures and lobules. Except in those cases ıey are accompanied with a carcino- ltration, they have generally narrow ted bases.

Fig. 259.



Papillomata upon the Glans Penis.

rm growths occasionally arise from of the nail and project between the ıail and the integument; and I have vo examples in which, the hypertro- ıg at the base of the nail, the papil- ıushed through the integument and ıall fungus of about the size of a pea, both of which were d by excision and caustic.

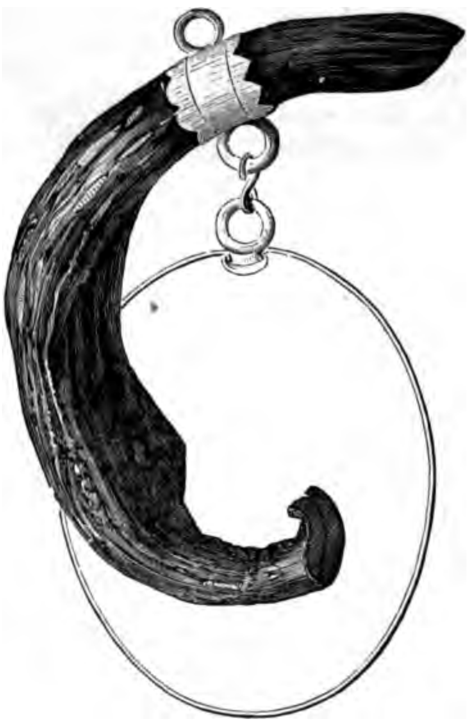
ınt.—The treatment of papillomata accompanied with a ıfiltration will be considered in connection with epithelioma orms of malignant growths. When of syphilitic origin they d specific treatment, although, in general, they yield pretty udiciously selected local applications. Simple, non-specific may be removed by the knife, by evulsion and by cautery. ıny cases, also, they possess so low a degree of vitality that rs, such as pulverized chalk or the lapis calaminaris, are cause their disappearance; or they may be destroyed quite ler the application of the dry persulphate of iron, or of pul- guinaria. Chromic acid is a favorite application with many

Warts. Syn., Verrucœ, R. C.—Papilliform growths occurring upon the integument generally assume the form of warts, which term is applied to papillæ hypertrophied and covered with an excess of epidermis.

Verrucca simplex, or the common wart, is seen, most frequently, upon the hands of children, between the periods of infancy and puberty. Warts occur singly or in groups; and there is reason to believe that they spread occasionally by contagion; such at least is believed to be the fact with all growths of this character which furnish a moist secretion from their surfaces, but there is some evidence that even dry warts may spread in like manner.

Treatment.—In most cases warts of the variety now described disappear spontaneously; but their disappearance may be accelerated—so little power of resistance do they possess—by various astringent lotions, and especially by the application of the persulphate of iron. The occasional application of the nitrate of silver will generally succeed; but the most speedy cures are effected by the knife, or by nitric acid, applied to the centre of the wart by the point of a piece of sharpened wood. Common warts seldom or never degenerate into sores during early life; but those which continue into old age are prone to a malignant epithelial degeneration, especially if subjected to injury or prolonged irritation. I have reported to the New York Pathological Society four examples of epithelioma of the hand, and one of the leg, which occurred in old persons, in consequence of attempts to remove warts by the ligature. Four of these examples demanded amputation, and one was cured by caustic applications.[1]

Fig. 260.



Horn from scalp of Elizabeth Low. Natural size. Bennet.

Verrucca digitata. Warts similar in structure to the common wart, but having longer and more completely separated papillæ, are seen occasionally upon the scalp, and which, in consequence of the peculiar finger-like tion of the papillæ, have been called verrucæ digitatæ. They d excision.

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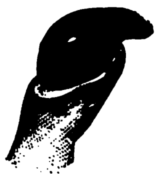
[1] New York *Med. Rec.*, June 15, 1868.

ı-like Growths. Syn., Cornua Cutanea, R. C.—Horny ex- ıces sometimes grow from the integument, and especially from e and scalp. In a few instances they have attained several in length. They belong properly to the class of tumors which now considering, being in most cases examples of moderately d papillæ with an excessive epidermal formation. In some he epidermic deposits of which they chiefly consist project from ous cysts or hair follicles; but their character is essentially the s in those examples which arise from the tegumentary papillæ.

upine Disease of the Skin, or Hystricismus, admits of the lassification. It is a peculiar disease or condition of the cutis gives rise to numerous scattered papilliform elevations, which e surmounted and enclosed by hardened epithelium.

ns upon the Nails.—The nails, and especially the nails of the oes, are liable to hypertrophy in the direction of their thickness. ve met with these cases most frequently in old persons and the poor, and particularly in old women at the hospitals, whose feet have been distorted by g tight and short shoes. It is probable that in ases, and perhaps in most others, the cause must ght in the long-continued irritation of the subun- natrix, occasioned by steady pressure, as a result ch the deposit of epithelium becomes excessive. often appear as large convex, or bossellated solid , and examples have been reported in which they isen to the height of one or two inches.

Fig. 261.



Horny growth upon the nail.

only radical method of treatment is excision of the hypertro- nail, including its matrix, or amputation. It is seldom, however, ese excrescences occasion sufficient inconvenience to warrant ons of so much severity, and the patients therefore seek pallia- filing them down, by sawing them off, or by scraping after long- ed maceration in alkalies; but they are in most cases so exceed- ard that either of these processes is found to be difficult and

ns. Syn., Clavi, R. C.—Corns are the results of pressure or of , and are occasioned, in most cases, by bad-fitting boots; the the construction of the boots being, generally, that they are too or too narrow beyond the metatarso-phalangeal articulations, in uence of which the toes are pressed together, or crowded into unnatural positions, causing projections and often hypertrophy of nts. The continued pressure or chafing of the boots upon these points gives rise to inflammation of the cutis, and consequent ve formation of epidermic cells. These cells are usually accu- d in greatest abundance toward the centre of the irritated surface, giving thus to the dried and hardened mass more or less of a conical form, the apex of the cone being directed toward the bone. When corns occur between the toes they are usually sodden with perspiration, and are called *soft corns.*

Treatment.—The remedies consist, first, in restoring, as far as practicable, the normal position of the toes. To this end the boot must have such width opposite the phalanges and to the very extremities of all the toes, as will permit them to spread and fall into line. It is not so much the overriding of the toes by lateral pressure which gives rise to hard corns, as the unnatural projection of the joints which the overriding necessarily occasions. Narrow-toed boots are quite as comfortable to the wearer at first as those which are broad, but they inevitably cause, when worn for a long time, angular projections at the joints which sooner or later become the seats of corns. In order to remedy this condition, therefore, the boots must be square-toed, broad, and of sufficient length. Second, the corns may be cut away, or, having been previously softened by warm water and soap, they may be removed by evulsion.

One of the most effectual remedies for a corn is the following mixture:

℞ Collodium flexile.......... ....Oi.
Ext. cannabis indicæ........ .... ʒ ij.
Acid. salicylic .... ℥ i.

This is to be applied freely with a camel's hair pencil, and on the fifth or seventh day removed by peeling it off, or by soaking in hot water. The corn will generally be found to have come away at the same time.

Soft, interdigital corns are in general the most sensitive, and the most difficult to manage. Some years since a young lady consulted me with a soft corn which had hitherto resisted every plan of treatment suggested by the most experienced surgeons, and which disabled her so completely that she had scarcely walked a mile during several years. She could only go out of doors in a carriage. I dissected up the integument from the interdigital surfaces of the adjacent toes, and, reversing the integument, pressed the toes together so as to secure adhesion between the raw surfaces, forming thus an interdigital tegumentary web. The cure was complete and radical.

In some cases corns cause absorption of the subjacent tissues and perforate the capsule of the joint, giving rise to synovial fistulæ or articular abscesses. In a case of this kind, occurring at the bottom of the foot opposite the metatarso-phalangeal articulation of the great toe, caused by contraction of the extensor tendons, I accomplished a cure by the section of these tendons.

Bunions.—The term bunion—literally, an eminence—is applied to those generally indurated elevations or callosities which form quite frequently upon the inner and upper margins of the metatarso-phalangeal articulations of the great, and at corresponding points of the little toes, occasionally upon the scaphoid bone, and upon other prominent points of the feet. They do not differ essentially from corns, except in the greater surface which they cover, in the less relative thickness of the epidermic layer, and in the more uniform presence of a distinct bursal sac beneath the callosity. I omitted to mention, when speaking of corns, that bursæ are occasionally found beneath the apices of their epidermic cones; but in the case of old bunions they are seldom or never absent. For this reason they are often classified with bursæ; but it seems more appropriate to arrange bunions with corns, inasmuch as they have more common points of resemblance, and they arise from the same causes.

Treatment.—The treatment of a bunion will not differ essentially from that recommended for corns. They must be relieved from pressure by properly constructed shoes, and protected more completely by fenestrated adhesive strips. They are subject to attacks of acute inflammation which demand absolute rest, and sometimes soothing fomentations or poultices. When the bursæ suppurate they must be opened freely, and granulation with cicatrization from the base must be encouraged. It is not advisable, however, to open them solely because they are distended with fluid, for the purpose of accomplishing a speedy and perhaps radical cure: at least such incisions ought to be made considerately, since not unfrequently the bursal sac is found to communicate with the capsule of the joint; and even when this is not the case, the exposure of the cyst is occasionally followed by intense inflammatory reaction. In some cases a cure can only be effected by excising the joint and straightening the toe.

These sacs are sometimes hæmorrhagic. In 1851 I was consulted by a gentleman having a bursa over the first articulation of the great toe, which had only recently formed, in consequence of wearing a tight boot. It was soft, elastic, and presented a purple appearance. Having made a free incision upon it there escaped uncoagulated blood, mixed with a glairy yellowish fluid. After evacuation the same dark, thin blood continued to flow for an hour or more, and was only arrested finally by the firm pressure made by a bandage and compress.

Keloid. Syn., Tumor Cheloides, R. C.—Gross, who has given a very full description of this disease, speaks of it as a variety of fibroplastic growth. Alibert, who first accurately described the malady, with many other writers, classifies it with the dermata. Addison recognizes two varieties of keloid, one occurring in integument which had suffered no previous injury, and the other occurring as a sequence of some tegumentary lesion and presenting itself primarily in the cicatrix. No doubt the malady may originate in either of the two ways named, but neither in the anatomical structure, in the symptoms, nor in the subsequent history do these two forms differ sufficiently to warrant a distinct classification.

Keloid occurs most frequently in the cicatrix caused by a burn; but I have met with it after excision of a fatty tumor, and as a sequence of other traumatic injuries; occasionally, as already stated, it appears spontaneously. It is more often seen in the colored than in the white races. It is characterized by white or pink-colored, hard or slightly elastic, smooth elevations; which may be round, ovoid, or cylindical in form, and which extend outwards from a central point in processes, giving to the whole mass a crab-like appearance, and hence the name keloid has been derived. When it originates spontaneously other similar growths are sometimes found in various parts of the body. In most cases they are accompanied with a troublesome itching, and occasionally with a burning or pricking pain. The progress of these growths is generally very slow, but steady, yet ulceration seldom takes place, nor have they hitherto been known to assume a malignant character.

Treatment.—After excision they generally return; and especially is this true of the variety which occurs spontaneously, or which has not been preceded by a tegumentary lesion. Empirically one might hope to derive benefit from the internal use of arsenic or of iodine, but in several of the cases which have come under my notice both have been tried faithfully, and with no result. I have seen them remain quite stationary for many years, and once I have found the tumor had disappeared spontaneously.

Cancer. Syn., Carcinoma, R. C.

Cancerous affections are no doubt sometimes hereditary, but they are not for that reason of necessity constitutional, since it may be only the predisposition which is inherited. They are probably, in most cases, primarily local. This latter statement needs confirmation, inasmuch as it conflicts with the views of many excellent surgeons and pathologists; nevertheless, there is much clinical and histological testimony in its favor. They are infectious in the sense that they spread to and involve contiguous structures of all kinds, and are carried, probably in most part, through the medium of the lymphatics, perhaps partly by the veins, to various portions of the body; but there is no evidence that they can be conveyed by infection or by inoculation from one person to another. In this latter, and thus far negative observation, there is presumptive evidence that the peculiar virus or cell-product of cancer demands for its existence and proliferation a favorable soil, in other words, a predisposition. They are never self-limited, except as they occasionally undergo a fatty or caseous degeneration, and in this new character disappear by absorption; or when they suffer spontaneous disintegration by strangulation, and slough; but, on the contrary, when once the focus of cancerous infection is formed, it tends to distribute itself more or less rapidly until the fatal termination. Hence these affections are called malignant.

Histologists have sought to establish a common anatomical character for all cancer growths; but hitherto their success has been only partial. Nor have they succeeded fully in establishing a common anatomical character for each distinct variety of cancer. Neither in the peculiarities of the cell formation, in the size of the nucleus and nucleolus, in the alveolar arrangement, nor in the distribution of the various elements, can we find a complete agreement of these neoplasms.

Recently the source of all cancerous growths has been sought in epithelial developments; thus Waldeyer defines carcinoma, "an atypical epithelial neoplasm." But Billroth observes that in cancer-tumors, besides the epitheliums, there are usually numerous young, small round cells which are infiltrated in the connective portion of the tumor and form an important part of it. Whether these latter are to be regarded as proper and peculiar constituents of cancer, and capable in themselves of propagating by infection, or whether they are merely accidental, and the results of epithelial penetrations and partial reactions upon connective tissue; and whether, again, connective tissue is not capable of developing epithelial cells in the same manner that epithelial structures are known to do; these are questions yet undetermined. Billroth inclines to accept the opinions of Waldeyer, which would make the epitheliums the sole representatives of cancer, and he would, moreover, prefer to believe that in the perfect orgasm there are no indifferent cells, or cells capable of producing others than their own type, and that consequently all cancer growths must proceed from original epithelial structure. So that, after all, these morbid structures may be found to be in no proper sense heterologous, and the histological distinctions will have to be sought in the profuse distribution and infiltration of epithelial cells which are well known to characterize these malignant formations, and perhaps in the consequent disappearance of all the original structure amongst which the epitheliums are deposited.

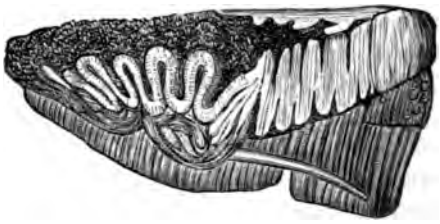
It must be understood, however, that while adequate results have not seemed to follow the prodigious labors of histologists in this direction, so that many incongruities remain to be settled and contradictions to be reconciled, very much has been accomplished, and we shall find material aid in the differential diagnosis of malignant and benign growths, in the size, form and number of its cells, nuclei and nucleoli; in the absence or presence of the alveolar formations; in the presence or absence of numerous small cells, resembling young connective-tissue cells; and in the limitation or wide dissemination and infiltration of all the adjacent structures with epitheliums.

The more precise clinical and histological diagnosis of cancer must be reserved for the individual forms and varieties.

Epithelial Cancer. Syn., Epithelioma, R. C.—That form of cancer usually denominated epithelioma is most frequently met with after the fortieth year of life. In a few rare instances I have seen epithelioma of the vagina and rectum in persons twenty or thirty years of age. Its most favorite seats are the lower lip, the integument of the face, the vagina, uterus and rectum; but all portions of the tegumentary, mucous and glandular structures are liable to epithelioma. Primarily, however, it very seldom attacks lymphatic glands. In rare and exceptional cases, also, it has been met with in the structure of the heart, lungs, liver, and in various other parts of the body.

The peculiar appearances presented in each case, according as it attacks primarily the one or the other structure, will be described in connection with the surgical accidents and diseases of the various regions of the body. It is only necessary here to state that epithelioma is often provoked, in an otherwise apparently healthy system, by long-continued local irritation of any kind; that its progress is usually slow; that for a long time, and probably so long as the neighboring glands are in no way implicated, it is undoubtedly a local affection; but that, left to itself, it invariably proceeds, generally after contaminating the general system, to a fatal termination.

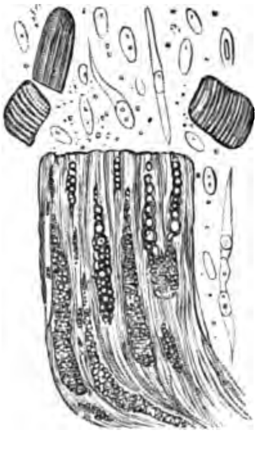
Fig. 262.



Section of an Ulcerated Epithelioma of the Tongue, with underlying Muscular Tissue. Natural size.

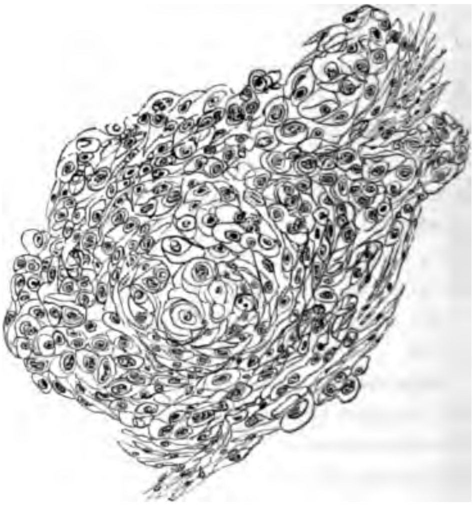
In a general way epithelioma may be distinguished from other morbid products of a cancerous character by its tendency to ulceration at an early period of its progress, and by its relative disinclination to t formation of massive outgrowths. Certain exceptions to these gener

Fig. 263.



Infiltrated Muscular Tissue, and Histological Elements, seen under unequal magnifying powers.

Fig. 264.



Epithelioma, 300 diameters. Arnold.

rules will be met with in all parts of the body, but especially in the uterus—where it often assumes the form of cauliflower excrescences—in the vagina, and upon the glans penis. The granulations, if they exist, are, in most cases, only a little elevated above the adjacent tissues, sometimes presenting slightly raised and irregular plateaus; but most often it progresses in the form of irregularly excavated ulcerations, with pretty well defined, jagged, and indurated margins.

The microscopical characteristics of epithelial cancer may be briefly stated as follows:—The cell element is almost exclusively epithelial, of varied shape and size. These arrange themselves in the form of "cell-cylinders;" several concentric layers of elongated or fibre-like cells course around groups of oval or round, flattened cells, and constitute the so-called "brood-nests," which are very characteristic. The "pearly nodules" are also met with—these being masses of condensed cell structures, exhibiting the concentric layer-like arrangement, and are of a yellow color. Their formation is due to the pressure exerted upon the "brood-nests" by the continued cell infiltration.

Treatment of Epithelioma.—There are three points in the preceding brief account of the origin, progress and nature of epithelioma which ought to serve as authoritative guides to treatment, namely:—First, that the disease, although, no doubt, usually depending in some sense upon a general predisposition, is at first essentially local; second, that it is infectious, or capable of propagation through the system; third, that prolonged local irritation ranks among the most active causes in its production. It would seem important, therefore, that it should be removed early, thoroughly, and that the subsequent cicatrization should be accomplished in the most speedy manner. Clinical experience here confirms what the semeiology and pathology of these morbid growths suggest: those epitheliomata have seldom returned which at an early period have been removed by the knife, and in which a considerable amount of apparently healthy tissue has been excised, including what might be termed their entire atmosphere, and in which at the same time it has been possible to close the wound and bring about prompt union, either by the drawing in of the adjacent tegumentary tissues or by transplantation. Tardy cicatrization, great tension of the cicatrix, and even the prolonged presence of a suture, favor their recurrence.

In certain cases the knife is inapplicable, and caustics have to be substituted; but just in proportion as these agents do not so faithfully fulfil all the indications named, they are found to be less efficacious. The caustics most frequently employed are the hot iron, the chloride of zinc, the acid nitrate of mercury and the potassa cum calce.

Hard Cancer.—Syn., Scirrhus, R. C.; Carcinoma Reticulare.—Hard cancer, like epithelioma, is perhaps in some cases hereditary; but it is proper to repeat here what has already been said elsewhere, that this admission does not necessarily imply that the disease is primarily constitutional, since it may be only a predisposition which is inherited, not a specific malady. It is very certain that a large proportion of persons born of parents who have suffered from scirrhus never manifest the cancerous diathesis, or become affected with cancer: and, notwithstanding the inveteracy and great mortality of scirrhus, there is much reason to believe that it is in most or all cases primarily a local affection; but that its existence depends, also, upon a certain constitutional fault or dyscrasy, which dyscrasy is usually coincident with the degenerations of age, if it is not actually synonymous with these conditions.

Evidence of the occasional local origin and character of scirrhus is found in the fact that epithelioma, in its progress or in its recurrence, often develops true cancer, either scirrhus or some of the equally malignant forms of carcinoma; recurrent fibroids frequently end in carcinoma, and even the most benign growths occasionally become malignant.

In testimony of the second proposition, namely, that the dyscrasy upon which the development of scirrhus depends may be that condition of the tissues, or of the processes of repair represented by age, it may be mentioned that scirrhus rarely occurs under the fortieth year of life, and almost never in childhood and infancy, and that it is exceedingly prone to attack the breast and other organs soon after their natural functions have ceased, when they are passing into a condition of senile decay. This is not a very encouraging view of the subject, since, if sustained, we cannot hope to arrest this malady in most cases except by re-establishing the normal forces of youth, in other words, by complete rejuvenation. Notwithstanding the fact that the specific local degenerations which characterize hard cancer are, probably, in the beginning limited to a single point and to a narrow circumference, from whence they are propagated centrifugally until at last the whole system is impregnated; yet so long as the predisposing, and, in this case, the most efficient cause, is of a nature not to be removed, or in any degree abated, very little encouragement can be given that excision or any other mode of extirpation, or indeed that any plan of therapeutics will accomplish a cure, or at least prevent the reproduction. In a few exceptional cases, when the operation has been made early and thoroughly, the result has been a complete and final success; nor are these exceptional results inconsistent with the doctrines above stated.

Scirrhus, when well declared, is characterized, usually, by excessive hardness, the hardness exceeding that of any other morbid growths, except enchondroma or osteatoma. In most cases the tumor is at first circumscribed distinctly; but occasionally, from the earliest period of observation, the carcinoma is disseminated more widely and the margins of the induration are imperfectly defined.

Its growth is usually slow and almost imperceptible, and when it occurs in the breast or testes the patient is sometimes induced to believe it is diminishing in size, on account of the gradual atrophy of the organs implicated. The surface is smooth or nodular. Pain, of a sharp, lancinating, and paroxysmal character is present in most cases, but it is often absent. It is generally tender and sensitive to the touch. In the early stages the general health is often apparently perfect, the skin presenting its natural color, and all the functions of the body being performed as usual.

At length the tumor is observed to be less movable under the skin; the skin sometimes appears depressed over its most salient point, and becomes purple, vascular, shining; it dries and cracks, or vesicates and opens, leaving an ulcer. The ulcer, as it increases in size, assumes an irregular form and is deeply excavated, discharging an offensive and irritating ichor.

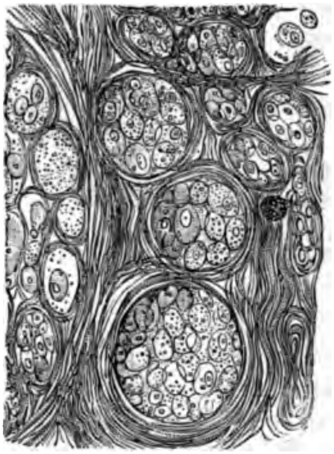
The neighboring lymphatic glands are by this time somewhat enlarged, those nearest the original tumor being first affected. It is at this period, also, that the cancerous cachexia or "carcinosis" begins to be manifest. The patient emaciates, the appetite and strength fail, and the skin assumes a grayish-yellow or clay color. As these tumors increase in size, the ulcers deepen, partly by gradual disintegration and partly by sloughing, but the process is never attended with healthy suppuration. If granulations occur they are fungoid, vascular and easily destroyed. Hæmorrhages are frequent, and the patient finally dies, worn out by the pain and exhausting discharges.

Hard cancer, left to itself, generally reaches a fatal termination in from two to three years after its complete announcement; more rapidly in those who are relatively young, who are in full vigor and who are fat and ruddy, or have a leucophlegmatic temperament, than in those who are very old, somewhat feeble, who are thin and possess a dry nervous temperament. In proportion to the rapidity of its growth, it is more likely to lose its distinctive character as scirrhus, and to approach the characters of the fungoid, medullary and colloid tumors. After death deposits of carcinoma are usually found in various parts of the body.

If the tumor is removed and examined before ulceration has taken place, or if a section is made of the indurated margins of the ulcer, the cut surface is hard, crisp and shining, of a bluish-white color, and presents to the naked eye an indistinctly-defined fibrous structure, resembling very much the cut surface of a raw potato, or of an unripe apple. When pressed, a thin, turbid, serous-looking fluid escapes, which is called the "cancer-juice." Portions of the interior may be, however, softened, forming one or more cavities or cysts, of irregular form and size, and containing matter of various degrees of consistence and of color.

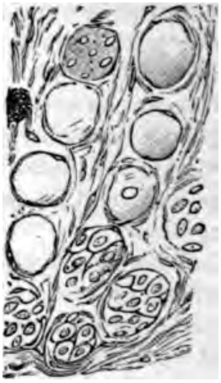
Under the microscope this tumor is found to be composed of fibrous or fibro-cellular tissue, forming a reticulated stroma or basis, within the meshes of which is deposited the cancer-juice, composed of a multitude of cells and free nuclei. The cells vary in size and form; their size ranging from $\frac{1}{600}$ to $\frac{1}{1700}$ of an inch in diameter, most of them being large and well defined, especially in those specimens which are matured. Their form may be oval, round, caudate, or spindle-shaped. They enclose one or more nuclei, which latter are usually nearly globular, or irregularly oval; and these in turn contain nucleoli. Free nuclei are found scattered in every direction through the cancerous mass. By the addition of acetic acid the cell wall is rendered more transparent, and in the case of young cells it is entirely dissolved; while the nucleus either remains unaffected, or it contracts and its outline becomes more defined.

Fig. 265.



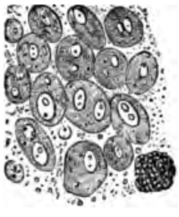
Arrangement of Cells and Fibres in a case of Scirrhus of the Breast.

Fig. 266.



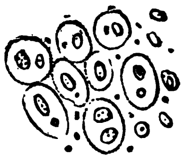
Same after addition of Acetic Acid.

Fig. 267.



Isolated Cancer-cells from same.

Fig. 268.



After addition of Acetic Acid.

In very old people, and sometimes in those who are younger, we occasionally meet with examples of scirrhus of the mammæ, which manifest a striking and remarkable tendency to shrink, and which in a few cases entirely disappear, leaving a contracted compact cicatrix.

ese have sometimes been called "*connective-tissue cancers.*" This rm of scirrhus has been particularly described by Billroth and others, d it has been denied by some that it ought to be classed under the arcinomata. Wernher terms it *cirrhosis mammæ*. Billroth—for good easons, as it seems to me—prefers to consider it as a variety of carcioma, but admits that its progress is usually very slow, and that its emoval permits a more favorable prognosis than in the case of most of he other forms of carcinoma.

Treatment.—Excision continues to occupy the position which it has so long held as the most important, if not the only remedy for this intractable malady. We may at least say, that in a large majority of cases no other remedy is equally deserving a trial; and, although we cannot by this procedure do more than encourage a hope that it will never return, or that the fatal event may be delayed, yet, since there is no resource which experience has yet proven of equal value, it should be accepted whenever it is practicable and the general condition of the system will warrant.

As to the mode and time of operation, something must be left to the circumstances of the case and to the judgment of the surgeon. In the sections devoted to regional surgery, these points will be considered as fully as the special examples will demand. In this place it is only necessary to say that early operations give the most favorable results, and that the incisions should be made well beyond the palpably diseased structures, so as to remove as far as possible the very atmosphere of the malady; or, to speak more correctly, in order that we may remove not only those portions manifestly infected, but also those adjacent tissues, into which it may be suspected that cancer-cells have become infiltrated.

Caustics, as a means of destroying cancerous growths, are infinitely more painful and more slow than the knife, and they are less radical; indeed, by repeated well-observed facts, I have proven that cancer returns more speedily after removal by caustics than after removal by the knife. They are to be employed, therefore, only when for anatomical reasons the knife cannot be.

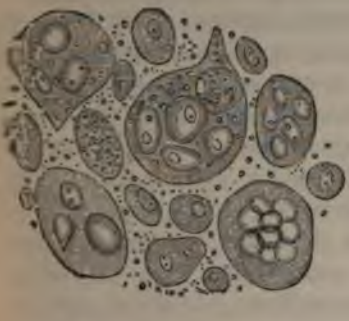
In regard to the various remedies which at one time and another have been regarded as specifics, and which have not unfrequently received the testimonials of even intelligent physicians, not one has ever borne the test of experience. In our own day, the waters of a certain spring in Vermont, cundurango, carbolic acid, taken internally and applied externally, and acetic acid injected into the substance of the morbid growth, have been declared by a few surgeons to possess the power of destroying cancer-cells, and of eliminating the virus from the system. Without ever having entertained any faith in these assertions, yet not doubting that they were sometimes made in sincerity, I have thoroughly tried them all, and can assure my readers that they possess no value whatever.

Electrolysis, so much vaunted by certain specialists, in its power to decompose tissues, and to convert them into their original elements, has some title to consideration as a local measure. It may be regarded as in some sense a substitute for the knife; but it is far from being as certain a means of destruction or of removal of the morbid growth; indeed its ability to chemically decompose and to cause absorption of the growth is exceptional; probably not more than one in thirty, perhaps not even a much smaller proportion, have ever been successfully and temporarily discussed by this method, while it is equally painful as the knife, more tedious, and more liable to such accidents as erysipelas and pyæmia. But of the claim lately instituted that electrolysis, conjoined with general faradization, is capable of eliminating the cancer virus from the system, it is proper to say that the claim is not supported by any carefully-made and well-attested observations; and when gentlemen occupying the position of educated physicians and surgeons, presume, upon the state of the evidence as it now stands, to say to the contrary, they justly place either their integrity or intelligence under suspicion. That electrolysis will occasionally cause the disappearance of a scirrhous deposit, and still more often greatly abate or remove entirely the accompanying neuralgic pains, from which these patients often suffer severely, I have verified by experiment, but this is all that can yet be said of it, in its relations to scirrhus or any other form of cancer.

Medullary Cancer. Syn., Carcinoma Medullorum, R. C. Encephaloid. Encephaloma.—Under this term writers have generally included all those cancerous tumors which present the color and consistence of brain. Most of these growths possess, also, more or less of a fibrous structure, and hence they are sometimes denominated *medullary sarcomata.*

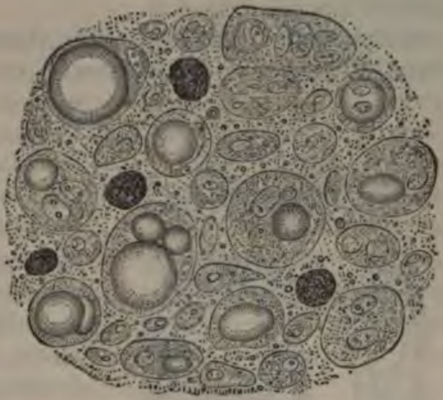
Encephaloids are exceedingly vascular, and in some cases they throw out a prolific fungus, which is subject to constantly-recurring and severe hæmorrhages. When it presents itself in this latter form it has, by Hey, been designated as *fungus hæmatodes*, or bleeding fungus, and it is popularly known as *rose cancer*. Encephaloids occur at all periods of life, in the young as well as in the aged; and they are less elective than scirrhus in their primary location, attacking with less discrimination nearly all the tissues of the body. In general, also, their type of malignancy is more intense, the constitutional cachexy is more early developed, and their fatal termination is more speedy. Scirrhus frequently passes gradually into encephaloid, and the histological distinctions, never very broad, are sometimes so completely lost that it is impossible to classify them: but the connective tissue is in general much less abundant in the latter, they are more vascular, the cells are not so closely packed together, but they are loosely deposited in a more abundant and fluid basis substance, they are larger, with more defined and more numerous nuclei—in short, they seem to indicate a higher and more complete cell development, if this expression can properly be applied to what is only a retrograde development, or in the direction towards failure, disintegration and death of cell-growth. They represent, in fact, feeble, perishable, but ectatic abortions.

Fig. 269.



Highest development of Cancer-cells. Encephaloma.

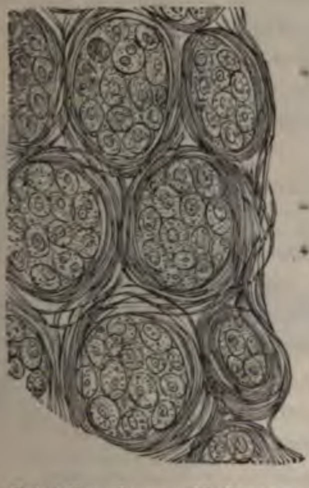
Fig. 270.



Simple and Compound Cells from Encephaloma of Duodenum. Several distended with fluid by Endosmose. 250 diameters.

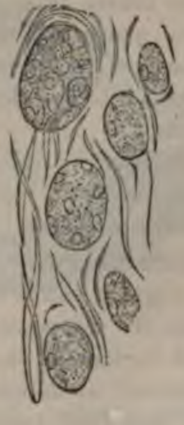
Medullary cancer has generally an irregular, nodulated form, some portions of which are usually soft and elastic, feeling very much as if they contained pus, while other portions are more firm; it grows in most cases with rapidity, and the surface assumes a mottled, purplish or vascular and shining appearance. Its boundaries are not always well defined, its base being generally much broader than its summit. When

Fig. 271.



Gelatiniform Cancer. 250 diameters.

Fig. 272.



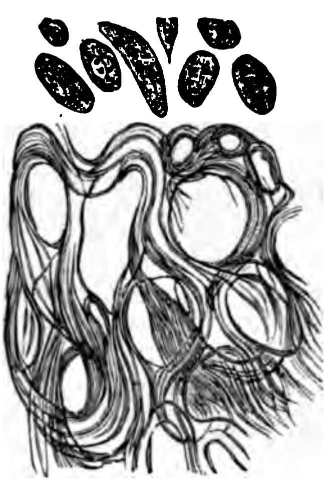
Same, treated with acetic acid.

it opens spontaneously or is opened freely by the knife, it seldom closes again, but either ulcerates or throws out an irrepressible fungus.

Treatment.—Early and complete extirpation by the knife is our only resource. When encephaloma attacks the extremities, amputation is the proper alternative. Occasionally, but not often, the knife has accomplished a permanent cure.

Gelatiniform Cancer. Syn., Carcinoma Alveolare, R. C.; Mucous, Myxomatous, Gelatinous or Colloid Cancer.—This form of cancer occurs most frequently in the ovaries, the testes, in serous membranes, especially the peritonæum, in the stomach and large intestines. It, in general, grows rapidly and to a great size. It is often associated with other forms of cancer, such as the hard or fibrous or the medullary, and in such cases its malignancy is intensified; but when pure, as frequently happens in colloid of the ovary, it is the least malignant of all the forms of cancer, the patients perishing finally rather from the enormous volume and pressure of the mass than from the extension of the disease to other parts or from any special infection of the general system.

Fig. 273.



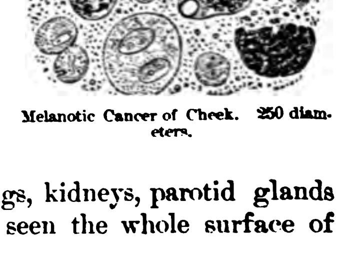
Fibrous stroma deprived of the cells by pressure and washing. 250 diameters.

In colloid cancer the fibrous stroma forms loculi, which are filled with a gray or amber-colored fluid, having a gelatinous consistence, and which sometimes nearly transparent and in other cases more opaque. The gelatinous matter occupying the areolar spaces may be completely structureless or it may contain well-developed nucleated cancer-cells.

The treatment is the same as for other malignant growths.

Melanotic Cancer. Syn., Melanosis, R. C.; Black Cancer.—Whenever the pigmentum nigrum enters to any considerable extent into the structure of a carcinoma, it is termed melanotic cancer; and this has been observed to happen most frequently with the medullary varieties. Pigment is most often seen in those cancerous deposits which occur upon or beneath the skin, or in connection with the iris; in the liver, lungs, kidneys, parotid glands and lymphatics. In one instance I have seen the whole surface of

Fig. 274.



Melanotic Cancer of Cheek. 250 diameters.

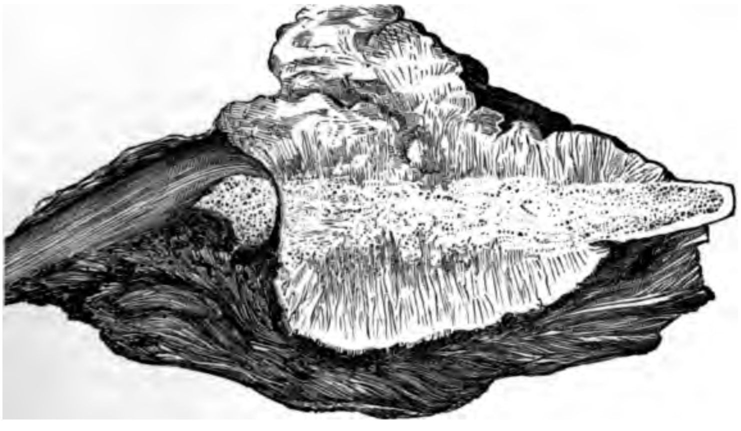
the body studded with melanotic tubercles, which in the course of a few months invaded also the internal structures of the body, and thus eventually proved fatal. In two examples, the melanotic growths being removed, they have not returned, the patients surviving the operation many years. It is not certain, however, that in either of these latter cases the disease was cancerous.

Osteoid Cancer. Syn., Carcinoma Osteoides, R. C.; Osteo-cephaloma.—The bones most liable to cancerous affections are the superior maxilla; the femur and tibia, in the neighborhood of the knee-joint; and the humerus; but all the bones of the body are liable to become affected in a similar manner.

The growth of these tumors is usually rapid, and in most cases it is accompanied with severe pain. The enlargement has generally an irregularly globular form. The skin presents, after it has attained a considerable size, a tense, shining surface, and is of a reddish or purplish color, in consequence of the venous congestion. Portions of the tumor have usually an elastic feel, leading often to the suspicion that it contains pus, while other portions are firm and unyielding.

A section of the tumor may show that the bony structure growing from the interior of the medullary canal in the form of osseous rays, diverging from the centre, composes a considerable portion of the entire mass; or the outer laminæ of the original bone may alone remain as a thin, expanded and perforated shell, while the interior is filled with the cancerous mass alone.

Fig. 275.



Osteoid Cancer of the Tibia.

In other examples the encephaloid growth has evidently commenced from without, probably from the periosteum, and the central portions may not have been invaded, or but to a limited extent; while spicula of bone are seen radiating from the periosteum toward the periphery of the tumor.

In osteoid cancer, the muscles are often found of a dark color and softened to a considerable distance from the seat of the tumor; indicating the wide dissemination and infiltration of the cancerous material. It must be understood also, that, owing to the facility with which internal communication is carried on between different portions of the interior of the shaft of long bones, through the medium of the medullary vessels, an early infection of the entire bone is inevitable.

Treatment.—Early and complete ablation of the diseased structure offers the same encouragement in this as in other forms of cancer; since in a few exceptional cases the fatal event is thereby considerably postponed, while in others, excision or amputation having been practised, the disease has never returned. When the extremities are the seats of the malady, amputation is the proper resort; and, whenever it is practicable to do so, the amputation should include the whole of the affected bone. Thus, for example, when the disease invades the tibia, amputation should be made at the knee-joint, or through the lower portion of the shaft of the femur. The extreme danger to life from an amputation at the hip-joint, may warrant an occasional departure from this rule when the lower end of the femur is the seat of the disease. In such a case it may be proper to amputate just below the trochanter.

The great extent, also, to which the cancer material is apt to become disseminated in the course of the muscles, especially when the disease originates external to the bone, will render it proper always to consider whether we cannot safely make the amputation at a point above the origin of the muscles involved.

PART SECOND

REGIONAL SURGERY.

CHAPTER I.

INJURIES AND SURGICAL DISEASES OF THE HEAD, WITH OPERATIONS.

SECTION 1.—SURGERY OF THE SCALP.

Lesions of the Scalp.

THE integument covering the upper portions of the head, or the calvarium, is firm, relatively inelastic, and is united to the subjacent tendinous expansions by a compact areolar tissue. Its numerous vessels lie chiefly in this areolar tissue, and external to the occipito-frontalis tendon. Between the occipito-frontalis tendon and the pericranium the areolar tissue is loose and abundant. The cranial vault is composed, in the adult, of two plates; the external thin and elastic, the internal thicker and more brittle; the intermediate, medullary, or diploic structure being extremely vascular, both the veins and the arteries communicating freely with the outer and inner periosteal coverings.

These anatomical facts will serve to explain many of the phenomena usually accompanying scalp wounds and injuries of the skull. A slight blow received upon the calvarium may rupture any of the small blood vessels lying in the compact areolar tissue external to the occipito-frontalis tendon, and cause an immediate swelling. These swellings or **cephalæmatomata** which are so common in childhood, are usually round or oval in form, with pretty abrupt margins, tense and painful, but not at first discolored. They seldom suppurate, but after two or three days, when a portion of the blood has escaped into the adjacent cellular tissue, and serum has mingled with the original effusion, the tumor often feels soft and fluctuating at the centre, while the margins remain hard; indeed this condition almost invariably precedes the dispersion, and the tumefaction may now be easily mistaken for a depot of pus, or for a fracture with depression.

The treatment consists in the immediate application of cold and pressure to arrest any farther hæmorrhage; and subsequently, in the employment of those means which may be necessary to control or prevent inflammation. There is no evidence that the so-called "discutients" have any power to hasten the assimilation and absorption of the blood which has been thus effused. If pus forms under the skin of the forehead, it should be evacuated by incision, to avoid a serious scar;

if left to itself it comes to the surface readily in the course of [illegible] days.

Much more rarely, in consequence of a blow upon the head, a swel[illegible]g occurs in the loose areolar tissue beneath the occipito-frontal[illegible]is ndon, but which is not constantly the result of extravasation [illegible] lood, being caused, usually, by a diffuse inflammation, which in mo[illegible]t ases terminates in suppuration. This swelling occurs later than th[illegible]t aused by the effusion of blood; and when suppuration takes place, th[illegible]e matter reaches the surface with difficulty.

There is, also, a variety of swelling caused by a blow upon the hea[illegible], which is due to an injury of the periosteum, or of the outer plate of t[illegible]e skull, sometimes to a lesion of the medullary tissue of the skull, incl[illegible]ding the diploic sinuses, characterized by the lateness of its occurren[illegible]e —seldom being observed earlier than the sixth or seventh day—and b[illegible] the frequent concurrence or early supervention of cerebral symptom[illegible]. The tumefaction at the point of injury is more circumscribed than in the preceding variety, and the integuments immediately overlying and adjacent are infiltrated with serum, and convey to the finger the usual sensations caused by œdema. Suppuration in these cases is generally inevitable, and necrosis of the outer plate can only be avoided by early evacuation of the pus. Indeed, the free communication established between the dura mater and pericranium through the cranial vessels, exposes the patient always to the danger of meningeal or cerebral effusions. As in the case of injuries of the medullary tissue of the long bones, so here, also, pyemia and metastatic abscesses may ensue upon the injury done to the diploic sinuses.

Cephalæmatomata are met with occasionally in newly born children, which are due to an extravasation of blood underneath the pericranium. Vogel says that this variety of bloody tumors (*cephalæmatomata subpericranium*, or *thrombus neonatorum*) is so rare that it is not met with oftener than once or twice in a thousand births. At first, and for a few days, it is generally concealed by the œdematous swelling or *caput succedaneum;* but as early as the fourth or sixth day it may be distinctly felt as a circumscribed, elastic, or fluctuating swelling upon one or the other of the parietal bones, but most often upon the right. At a later period, a bony deposit occurring upon the inner surface of the elevated periosteum, the tumor presents a hard margin at its base, and imparts a crackling or parchment-like sensation when pressed upon over its centre. No surgical interference is required in these cases, inasmuch as when left to itself the blood is gradually absorbed, and in the course of a few months the swelling entirely disappears.

Wounds of the scalp bleed freely, and the vessels, retreating into the dense subtegumentary areolar tissue, cannot be easily secured by ligatures; fortunately, however, they either cease to bleed spontaneously, or they may be closed effectively with moderate pressure, applied by means of a compress and bandage. Vessels which have retracted, and cannot be readily seized with the forceps, can be at once brought into view by an incision made at right angles with the wound; when, by reversing the flap, they will be seen or felt upon its under surface, and can be readily secured.

When a large portion of the integument has been torn up, the flaps cannot usually be made to close completely without putting the integument into a state of tension. In such cases no attempt should be made to secure perfect apposition; but the flaps, being thoroughly cleansed, should be laid carefully in place, and covered by a broad piece of sheet lint spread with simple cerate, the whole being supported by a few light turns of a roller.

Whether the wound is large or small, sutures are, in general, inadmissible; nor do I ever advise closing up the wound completely with adhesive plasters. Cases of this kind are constantly brought into the wards of Bellevue Hospital with the scalps neatly shaved, the wounds closed hermetically by adhesive plasters, and bound with rollers, which, on examination, are found to be doing badly; the straps being already lifted by imprisoned pus or ichor, and the margins of the wound presenting an erysipelatous appearance.

Tumors of the Scalp.

Cystic Tumors, of that variety caused by obstruction of sebaceous and hair follicles, are quite common upon the scalp. Frequently two or more are found to exist at the same time. These tumors seldom exceed half or three-quarters of an inch in diameter, although they occasionally attain a much larger size: they are round, smooth, slightly elastic, and in most cases the hair overlying the tumor is thin and scattered, or it has entirely fallen out, leaving the scalp bald.

Treatment.—Except that they cause a deformity, or occasion some annoyance in the dressing of the hair or the wearing of a hat, they might be permitted to remain, inasmuch as they are always benign and simple in their character. Excision is the only remedy; but owing to the peculiar proneness of the scalp to erysipelatous inflammation, they ought not to be interfered with when inflamed, or when the general health is impaired; care should always be taken, also, not to wound the subjacent tendinous expansion.

Erectile Tumors, occurring upon the scalp, are generally congenital. They may be either capillary, venous, or arterial. When situated directly over the anterior fontanelle, and occupying the subcutaneous areolar tissue, they may be mistaken for hydrocephalic protrusions or for encysted tumors. One of the most diagnostic marks is the presence of longer and stouter hair upon the surface of the erectile tumor than elsewhere upon the scalp. In the case of encysted tumors the hair is usually thin or absent, and in hydrocephalus it is normal. Care must be taken, in attempting a differential diagnosis of tumors situated over fontanelles, not to confound the pulsation of the brain with a pulsation in the tumor itself.

Treatment.—Erectile tumors, occurring upon any portion of the scalp, demand the greatest circumspection in the application of surgical measures, both on account of the danger of propagating inflammation to the meninges, especially in the case of children, and of awakening inflammation of an erysipelatous character in the integument. If the tumors are small, excision should be preferred; but large erectile tumors of the scalp must be attacked by the ligature, the cautery, or electrolysis, and in most cases we give preference to the latter.

It is very seldom that the surgeon meets with any other forms of tumor upon the scalp than those which have been named. Occasionally, however, we meet with fibrous, papillomatous or adipose tumors, and still more rarely with one of the following.

Fungus of the Dura Mater ought, no doubt, to be regarded as one variety of tumors, since it is a distinctly organized growth or fungus arising from the outer surface of the dura mater, and causing a gradual absorption of the bony covering. When the osseous shell has become sufficiently thinned, it presents itself as a defined, abrupt eminence, pulsating, elastic, and capable of being pressed back within the cranial vault. At this period, also, it conveys to the finger a crackling or parchment-like sensation.

The prognosis is unfavorable, but the only remedy is the enlargement of the cranial aperture and a careful dissection of the tumor from the dura mater.

Fungus of the Skull is a similar growth from the medullary tissue or diploë of the skull. Sometimes the structure is fibro-cellular, or fibro-vascular; at other times it is encephaloid, or myeloid. It is distinguished from the preceding variety chiefly by the fact that it does not pulsate, and cannot be made to retire into the cavity of the cranium. The treatment is excision.

If pulsation exists, but the tumor cannot be made to recede within the cavity of the brain, there will be reason to believe that the growth constitutes an example of that form of tumor usually known as *aneurism of the bone*, and no operation save ligation of the carotids could be deemed justifiable.

SECTION 2.—CONCUSSION AND CONTUSION OF THE BRAIN.

Concussion of the brain may be caused by blows received directly upon the head, or by a fall upon the feet, the impulse being conveyed to the brain through the spinal column. There are several degrees of concussion, characterized by special symptoms and, to some extent, by corresponding conditions or lesions of the brain. It is true, however, that the degree of lesion cannot be determined accurately, and not always approximatively, by the symptoms.

In the first and simplest form of the accident, there may be simply momentary confusion of intellect. To this class belong many of those railroad accidents caused by collisions, in which no part of the body has been severely bruised, the patient at first believing that he has received no serious injury, when in fact the whole body, including the brain and spinal marrow, has suffered a severe shock, occasioned by the sudden arrest of motion. In examples of this class, it happens not unfrequently, that after a time, perhaps not until after the lapse of several days or weeks, the mind becomes irritable, the memory fails, hearing and vision are impaired, and the whole system is greatly disturbed in consequence of deficient, exaggerated, or irregular innervation. It is probable that in such cases the brain and other portions of the nervous system have suffered only commotion, or an intense vibration, which has been followed at a later period by reaction, congestion, and, possibly, a low form of inflammation.

In the second variety, the patient, receiving a blow upon his head, staggers and falls, and for a few moments, only, is unconscious. Hewett, in his admirable treatise on injuries of the head, in Holmes' Surgery, has mentioned two cases of this kind, in which the sudden death of the patients from other causes has enabled him to furnish very strong presumptive evidence that at least minute miliary extravasations occur in many examples of this class; in short, that there is often present something more than simply cerebral disturbance, or congestion.

Third, when the blow is heavier, the loss of consciousness is more prolonged, but reaction and recovery finally ensue. In such examples there may be not only congestion, with disseminated blood-specks, but also extravasation in masses.

Fourth, cases terminating fatally, after a period, longer or shorter, of complete unconsciousness. In these examples the lesions of which I have already spoken are more uniformly found, and not unfrequently there is added contusion, especially of the superficial cerebral structures.

It will, perhaps, always remain impossible to determine by the sensible phenomena the precise amount of injury done to the brain, for the reason that the gravity of the symptoms depends less upon the amount of lesion than upon the part of the cerebral mass which is affected; and we shall hereafter see that the lines of distinction between concussion and compression are not so broad and well defined as surgical writers have been accustomed to teach.

Symptoms of Concussion.—In general it may be said that the symptoms of concussion are those of partial and irregularly-distributed paralysis. They are as follows:—mental confusion, or unconsciousness; complete loss of muscular power, except that the limbs may move when persistent efforts are made to disturb or arouse the patient; the action of the heart feeble and often irregular; respiration feeble; retention or incontinence of urine; both pupils may be dilated, but in some they are contracted; or one pupil may be dilated and the other contracted.

Vomiting is among the earliest symptoms of returning consciousness, and may always be regarded as a favorable indication.

Treatment of Concussion.—The danger in concussion is not so much that the patient will succumb to the immediate effect of the injury, for this termination is exceedingly rare, but that the reaction will result in inflammation of the brain or of its meninges. The treatment, therefore, must consist in inviting the circulation to the surface of the body, and to the extremities, by warm applications and by mildly stimulating embrocations. Beyond this, very little can be properly done, except patiently to await returning consciousness, and, finally, to enjoin upon the patient, after the signs of concussion have disappeared, that he must make little or no mental or physical exertion during the succeeding week or two. Inattention to this latter precept has, in many cases under my own observation, been followed by the most serious results. When intra-cranial inflammation ensues upon these injuries its approach is usually insidious; but in most cases the febrile reactions become manifest by the fifth or sixth day, and sometimes as early as the second or third. In children it is often announced by convulsions.

SECTION 3.—COMPRESSION OF THE BRAIN.

The brain may suffer compression in consequence of a partial fracture and bending of the bones of the skull, as in the case of children or infants; from a complete fracture with depression in adults; from intra-cranial effusions of blood; from effusions of serum, and from the presence of pus or lymph, or other products of inflammation. Compression may be caused, also, by the growth of tumors and by various other causes, which it is not our purpose at present to consider.

Symptoms of Compression of the Brain.—All of the characteristic, but not all of the occasional and incidental symptoms accompanying compressions, indicate profound paralysis. They may be enumerated as follows: total loss of consciousness; dilatation of the pupils; the action of the heart slow, but the pulse full and soft, indicating loss of power in the involuntary muscular fibres of both the heart and arteries; respiration slow and labored; stertor, occasioned by paralysis of the muscles of the velum palati; frothing at the mouth, and puffing at the lips, caused by paralysis of the buccal and labial muscles, the air mingling with the mucus as it is driven through the collapsed oral aperture; immobility of all the voluntary muscles; insensibility of the skin; retention of urine and of fæces, sometimes replaced by incontinence; distention of the stomach and intestines with gas, implying arrest of digestion and consequent fermentation of the contents, accompanied with paralysis of the involuntary muscular fibres of these viscera; congestion, and purple hue of the skin, due to imperfect action of the lungs and heart.

When these distinctive signs of compression alone are present, no doubt can be entertained as to the character of the accident; but there may be present, also, violent tetanic or clonic spasms of certain muscles, especially of the muscles of the upper or lower extremities; one or even both of the pupils may be contracted; delirium may, at an early stage, alternate with, or be substituted for coma, and many of the other symptoms may be so modified, or so lessened in degree, as to render it uncertain whether the accident should be classified as concussion or compression. In fact, pathology does not to-day furnish us with any exact limitation between these two forms or degrees of lesion; and it is only to those examples which do not approach the border lines that we can assign a definition.

The *pathology* and *treatment* of compression will be considered in connection with its special causes, which constitute the basis upon which its several varieties are established.

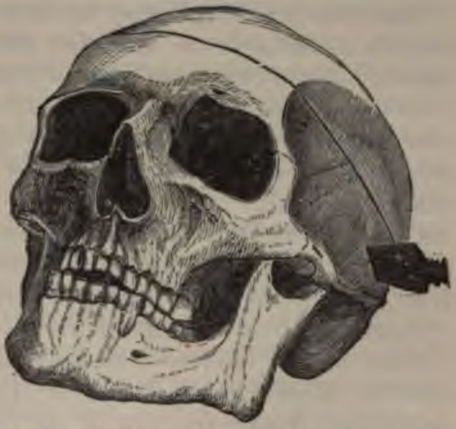
SECTION 4.—FRACTURES OF THE SKULL.

Contusion of the skull, grooving, indentation, depression of the inner plate alone, and punctured fractures, have already been considered in connection with scalp and gunshot wounds.

The following interesting examples of *punctured* wounds of the skull, caused by arrow-heads, will, however, be mentioned in this place, their history having been received too late to be recorded in the chapter on arrow-wounds.

The first is the case of a soldier killed by a Comanche Indian in Texas, on the 30th of September, 1870. The arrow-head entered the squamous portion of the left temporal bone, and penetrated the left hemisphere to a depth of one inch or more, causing an intercranial hæmorrhage, which was speedily fatal. There is no fissure or splintering of either the outer or inner tables.

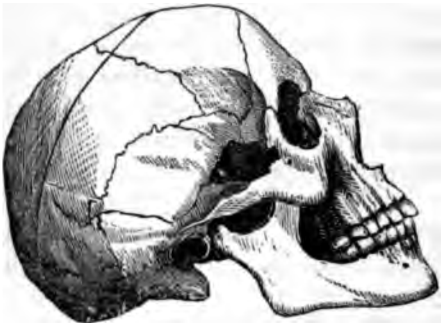
Fig. 276



Iron Arrow-head impacted in Left Temporal Bone, without Fissures. No. 5908, Sec. 1, A. M. M.

The second, a soldier also, was wounded, September 1, 1870, in an attack made by Indians near Pecos River, Texas. In addition to the arrow-wound in the head, he received three flesh-wounds from balls. He was admitted to the Post Hospital on the seventh day, having travelled a long distance on foot and by stage. He spoke very lightly of the scratch on his head; and the head of the arrow being buried beneath the integument, and no cerebral symptoms being

Fig. 277.



Result of Arrow-head impacted in Right Temporal Bone. No. 5907, Section 1, A. M. M.

recognized, the presence of the missile was not suspected. The gunshot wounds healed kindly, but on the eleventh day febrile symptoms were ushered in, and on the nineteenth day he died. The autopsy showed that the arrow-head had entered the squamous and petrous portions of the temporal bone, where it remained impacted. Pus was found in the ventricles and upon the meninges.

Dr. Otis remarks, in a note appended to these cases, that in all of the specimens contained in the Army Medical Museum, where both plates of the calvaria are penetrated by arrows, there is little or no fissuring, either externally or internally, the arrow-heads being literally impacted, and the inner table penetrated as cleanly as the outer; an observation which is in "marked contrast to the results of bayonet or sword thrusts, or of the impact of gunshot projectiles," and which does not fully correspond with the observations of Bill, who found the outer table, in most cases, slightly fissured, and the inner table somewhat splintered and depressed.

Fractures of the skull may be caused by "direct" blows; in which case the lesion occurs at the point where the blow is received. To this class belong not only those cases in which the weapon impinges directly upon the surface of the skull, and the fracture is at the same point, but also those in which the patient falls upon the feet, and the concussion, being conveyed through the vertebral column, causes a fracture at the base of the skull.

Occasionally, also, fractures are caused by indirect violence, or by counterstroke—*contrecoup*—the lesion occurring at some point remote from, perhaps opposite, that upon which the blow was received.

Fractures of the skull admit also of the following divisions:—

First, partial fracture with bending of the bones, which can only occur in children; second, fissures; third, fracture of both plates with depression; fourth, fracture of the external plate alone, with depression; fifth, fracture of the internal plate alone, with depression. They are also said to be linear, stellated, camerated, punctated, etc. In rare instances, the bones separate at their sutures, constituting examples of cranial diastasis.

Fractures of the Skull in Children.

In a majority of these accidents the fracture is complete; but occasion-ly the bone is bent in or indented, rather than broken; and in some ses the fracture is complete at certain points and incomplete at others hichever variety of accident has occurred, if it has happened in early fe, the case possesses certain peculiar features in regard to the symp-ms, treatment, and results, which demand for it separate consideration.

Until the second°or third year of life, and in some children until much later period, the fontanelles are open, so that at birth, and for ome time subsequently, the brain can easily accommodate itself to ny changes in the form of the bones, and suffers little or no compres-ion from a fracture with depression. In early life, also, the cranial ones are thin, and contain a relatively small proportion of earthy mat-er, in consequence of which they yield easily to pressure; and they ossess a considerable elasticity, which enables them, in many cases, to esume their places or original forms spontaneously, sometimes quite uddenly, but in general only after the lapse of several weeks or months. Moreover, even when the fontanelles are not open, and the depressed bone does not resume its place spontaneously, and is allowed to remain depressed, very often no signs of compression are present, because the other cranial bones have yielded, probably in the line of their sutures, ufficiently to compensate for the encroachment upon the intra-cranial pace at the point of depression; so that we see children grow up to dult life with the depression remaining, but who have never experienced from this cause any permanent injury or inconvenience.

To be more precise—It happens from these anatomical peculiarities that children often suffer extensive fractures of the skull, accompanied with depression, without presenting any signs of compression; and in uch cases it is always proper to defer surgical interference, trusting ither that the bones will resume their places, or that no harm will come f their being permitted to remain depressed. Many years since, I called ttention to these facts, and published several cases in illustration,[1] one r two of which it will be proper to mention. A male infant, fourteen onths old, was thrown from a sleigh while the horses were running, triking his head against the corner of a curb-stone. I saw him four ours after the accident, at the request of the physician in attendance, who had written me a note saying that "the whole side of his head was riven in." The statement did not seem to be exaggerated, inasmuch s nearly the entire parietal bone upon one side was broken into several ragments, or partly broken and partly bent, and very much depressed; ut the child was nursing at its mother's breast and seemed bright, and ave no indications of having suffered any serious injury. Cooling lo ons were directed to be applied, and three weeks later he was brought me quite well, with the bones nearly restored to their original ositions.

The infant son of an Indian chief, aged five months, was thrown from a carriage, striking upon his head and causing a fracture with depression of the right parietal bone. The child cried violently, but was never insensible. When brought to me, two weeks after the accident, he was well, but the chief thought the bone ought to be lifted. A cast taken at that time, still in my possession, shows a depression of two inches in extent by half an inch or more in depth. The parents were only requested to advise me if alarming symptoms supervened; and now, after twenty-four years, he is a strong, healthy, and intelligent man, but the depression can still be plainly felt.

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[1] Fracture of the Skull in Children. *Buffalo Med. Journ.*, Nov., 1846, p. 347.

It is remarkable, indeed, how cases of even much greater severity accompanied not only with extensive depression, but with the usual signs of compression, also, will now and then recover, as the following example will illustrate. A child, three years old, while playing in a barn, was struck upon the left side of his head by a piece of timber, called a scantling, which had fallen from the loft, crushing in the bones and nearly extinguishing life for a time. My old friend, Dr. Gilmore, of Scipio, N. Y., who was in attendance, desired me to consult with him. We found the whole length of the parietal bone broken, in two parallel lines, intersected in the centre by a cross-fracture, at which central point the depression was very great. The child was completely comatose. The parents, being advised that an operation was in our opinion necessary, in order to lift the fragments, refused to give their consent, and the case was left in charge of Dr. Gilmore. On the third day consciousness had partially returned; on the twelfth day he spoke, and from that time continued to improve until the bones had resumed their original position and until his recovery was complete. In the late war of the rebellion he was killed, while acting as a private soldier in the Federal army.

It is not to be inferred, however, from the fact that this child recovered, that it would not be proper in such cases to operate. The rule might be stated to be, that, when no signs of compression are present, surgical interference would be improper; and that, when they were present, it would be advisable in most cases to delay interference some hours or even days, or until the prognosis was better declared.

We must regard it as fortunate that the elevator and trephine are not demanded so often in children as in adults, since with the former, elevation and trephining are much more difficult and delicate operations than with the latter. In using the trephine, in the case of infants, the pin can scarcely be employed with safety, lest it should penetrate the thin shell of bone; and the absence of the diploic structure deprives the surgeon of an important indication as to the depth to which the crown has penetrated. I have once seen a surgeon bury the crown of his instrument in the brain of a child five or six years old, in consequence of its sudden and unexpected penetration of the skull. The danger of penetrating the membranes is increased, also, by the firmer adhesion of the dura mater to the skull in early than in middle life

In adults this membrane is frequently separated by the force of the concussion, the space being occupied by blood, but in children this rarely happens. In a few cases the rongeur may take the place of the trephine.

There is another and a very serious difficulty in the way of elevating the cranial bones of children by the levator, whether the trephine is employed or not, especially in the case of infants, namely, that the flexibility of the bones is so great that they bend at the point where the levator is applied, and cannot be lifted in mass; consequently the surgeon is compelled to enlarge very greatly the tegumentary incisions, in order to apply the instrument under the depressed fragments at various points.

Children perish frequently after even slight injuries of the head; death being caused by cerebral irritation or inflammation, accompanied with effusions; and the accession of these grave lesions is generally announced by slight stupor, strabismus, twitchings or convulsions. It is doubtful, however, whether, considering the frequency of such accidents with children, they cause death any more often than do similar accidents occurring in adults. What I have sought especially to impress upon the reader as peculiar to childhood and infancy, is, that the depression of the skull, alone considered, is not so grave a complication as in the adult, and that elevation of the depressed fragments is at the same time more difficult and less urgently demanded.

Fractures of the Vault of the Skull in Adults.

Fissures.—The existence of a mere fissure, without depression, cannot be determined positively unless the surface of the skull is exposed. And even then the surgeon must exercise some caution not to mistake a suture, a vascular groove, or the abruptly elevated margin of the lacerated periosteum, for a linear fracture. The latter I have found the most frequent source of error with young operators. In fractures at the base of the brain, which are often unaccompanied with depression, there are certain signs, hereafter to be enumerated, which will, in most cases, furnish presumptive evidence of their existence.

A fissure demands no surgical interference, unless intra-cranial suppuration ensues; an event which, contrary to the opinion of Pott, is too rare to be anticipated by so grave an operation as trephining.

Fractures of both Tables, with Depression.—First, let us consider the fractures belonging to this class which are unaccompanied with signs of compression, and in which there is no external wound communicating with the point of fracture.

In many of these examples it will be found impossible to determine positively the existence of a fracture; and under such circumstances no surgeon has probably ever felt authorized to incise the scalp in order to establish a diagnosis.

In other cases, however, the diagnosis is easily made, and the surgeon may then be naturally enough in doubt as to his proper line of conduct. The question is, I suppose, settled definitively in the minds of most surgeons who have had a sufficiently large experience, that it is seldom advisable in such cases to operate. And this conclusion has been reached on my part with a full knowledge of the fact that the omission to elevate the bones exposes the patient to certain risks in the future.

A state of facts may be easily supposed in which the rule above given ought not to be applied; as, for example, in adults when, although there is no external wound, nor coma, nor other sign of cerebral disturbance, there is plainly enough a very considerable depression of the skull, indicated by its deep and abrupt margins: and it is in such cases that my friend, Dr. Gross, would operate. I fully agree with him; but these conditions are, according to my experience, not often precisely fulfilled.

Second, when there is a fracture with depression, unaccompanied with an external wound, but signs of compression are present, the skull must be exposed and the fragments elevated or removed. Indeed the rule may be extended farther. If marked signs of compression exist an explorative incision is proper, even when there is a doubt as to the existence of a fracture; insensibility and coma being in both of these classes the ruling indication for surgical interference.

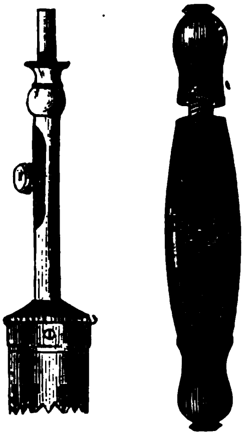
Third, a fracture with depression, accompanied with an external wound, but without insensibility coma, or delirium. Here is to-day the only debatable ground.

Certain exceptional cases are every now and then presented in which a considerable depression of the cranial vault exists, unaccompanied with symptoms of compression. The possibility of this coincidence has already been mentioned in connection with simple fractures of the skull, but it is certainly more common in connection with compound and comminuted fractures, in which cases the very excess of comminution and the looseness of the fragments obviates compression. In the first class I have authorized non-interference, notwithstanding the possibility of subsequent evils; in the last, however, the complications have already attained their maximum, and there is little or no probability that a careful removal of the fragments will add to them. It will therefore be wrong to expose the patient to the additional hazards inseparable from the continuance of the depression.

Fourth, a compound fracture, with depression of both tables, and with symptoms of compression. In this case prompt surgical interference is invariably demanded. The hair should be first cleanly shaven from the scalp in the neighborhood of the wound, and, if necessary, the wound should be enlarged so as to bring into view the whole depressed bone. It will now be found, in a majority of cases, that the fragments can be lifted without the aid of the trephine. With the elevator or the forceps, an entrance can usually be effected at some point which will at first, the removal of a small fragment, and eventually of the

saw is, in my experience, a worthless instrument, and ought longer to encumber an operating case. If the ordinary eleva not suffice, possibly a pair of sharp tters may remove a projecting spicu- bone, or the rongeur may accom- n entrance. Failing by all other nts, the trephine must be employed; the ordinary trephine with vertical or the conical trephine invented by

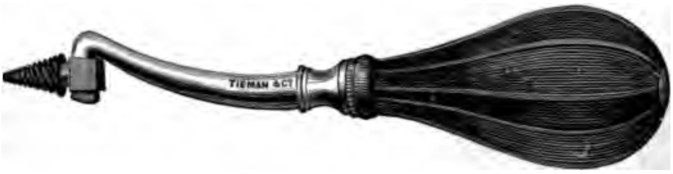
Fig. 278.



Vertical Trephine.

ing the ordinary vertical trephine, the st be placed upon some point of the erence of the fracture where the bone avoiding, wherever it is practicable, rtions as directly overlie venous sin- the great artery of the dura mater; ien the crown has made for itself a ng groove, the pin must be withdrawn. penetrating the external plate the may be used boldly, but after reaching the diploë great cau- required. The instrument must be often removed and the explored with a flattened and rather blunt probe, made of one or of a goose-quill. When the dura mater is felt at one he screw or common elevator will sometimes lift the disk. If ot be lifted, the trephine must be again applied and pressed nly upon the opposite side. In a large proportion of cases the ater is not found attached to the skull at any point of the erence of the fracture, and is so far removed that it is not in anger of injury. The injury, if any, inflicted by the opera- rather in the rude and hurried attempts to extricate the ed fragments. The inner table of the skull is in most cases obliquely, and beyond the circumference of the external , presenting sharp scales and spicula which underlie the outer nd which must be either broken with bone-cutters, a pair of lunt pointed scissors, or with curved or flattened bone-forceps,

Fig. 279.



Screw Elevator.

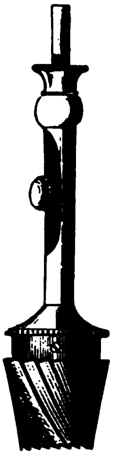
or they must be managed very adroitly to bring them out without lacerating the dura mater. Fragments which are completely insulated by the line of fissure do not necessarily demand removal. If they resume their places perfectly, and the periosteum still remains attached, they will generally unite to the adjacent fragments. No portion must be left depressed; and all spicula and sharp points must be removed.

The wound having been thoroughly and carefully washed out, the integument should be brought together and held in position, by lint covered with simple cerate, and bandages, or by adhesive strips.

The conical trephine invented by Galt, of South Carolina, is, in many cases, an excellent substitute for the ordinary trephine, inasmuch as with this instrument it is wholly impossible to inflict any injury upon the meninges of the brain. It consists of a truncated cone, with spiral peripheral teeth and oblique crown teeth; when applied, the peripheral teeth act as cutting wedges as long as counteracting pressure exists on the crown teeth; upon removal, however, of that pressure, by the division of the cranial walls, its tendency is to act on the principle of a screw; but, owing to its conical form, and the spiral direction of its peripheral teeth, its action ceases.

In the construction of the instrument it is important to preserve the precise relative shape of the cone given in the illustration—the size and course of the peripheral teeth being the same, whether the instrument be larger or smaller than that here represented.

Fig. 280.



Galt's Trephine.

When Galt first devised this instrument it was his impression that the cone was an original idea of his own, but, on examination of the atlas of Blasius, he learned that an instrument had been in use, having a conical shape, with longitudinal peripheral teeth. He found, however, after experimenting with it, that that instrument possessed very little advantage over the vertical trephine, inasmuch as it continued to cut after dividing the cranial walls, and consequently must be liable to wound the membranes.

Small chasms, made by removal of the bone in early life, sometimes become closed by new osseous deposits; but in later life the space is covered in only by the union of the soft tissues, which, however, after a time, acquire such a degree of tension and compactness as to furnish a very complete protection to the brain.

Fracture of the External Plate with Depression of the same, or Indented Fracture.—Over the frontal sinus such accidents are not uncommon, but elsewhere upon the cranial vault they occur very seldom. In most cases they are caused by some sharp or angular body which has not penetrated deeply. Except that, like contusions of the skull, they are liable to be followed by osteo-myelitis and other later complications, they do not demand special consideration. (See Superficial Gunshot Wounds and Contusions of the Skull.)

(*For fracture and depression of the internal plate, without fracture of the external, see Gunshot Fractures.*)

Fractures at the Base of the Skull.—In a large proportion of cases these accidents prove fatal. The fact of the existence of a fracture cannot always be determined; but the usual signs of its existence are:—

First, the escape of blood. If the anterior fossa is broken, blood usually appears first under the integument of the lower lid, and under the ocular conjunctiva. In three cases reported by English surgeons, the fracture at this point, accompanied probably by a rupture of the ophthalmic artery, has given rise to traumatic aneurisms; which, it may be proper to mention, were cured by ligature of the common carotid. When the line of fracture extends farther back, there may be extravasations of blood into the nose and mouth, through the external ear and the Eustachian tube, behind the mastoid process, or beneath the integument at the base of the occipital bone. A free and persistent haemorrhage from the ear is the only one of all these bleedings, however, which furnishes very conclusive testimony as to the nature of the accident.

Second, escape of serum: occurring most often after fracture of the petrous portion of the temporal bone, and in that case making its exit by the ear. Examples are recorded, however, in which, after fracture, serum has escaped from the nares, and from the vault of the cranium. Similar and profuse discharges of serum, Mr. Hewett states, have twice occurred from the ear after rupture of the tympanum, when there was no fracture. As to the source of this fluid there is some uncertainty. It is probable that it may proceed from one or more of several sources: from the blood itself; from the internal or middle ear; from the arachnoid or cerebro-spinal cavity; or from the ventricles even. In general its presence may be regarded as a sign of fracture, and especially when it appears early and is profuse, or when it is preceded by a copious and persistent bleeding from the ear. M. Robert thinks that profuse serous discharges from the ear, are more apt to occur after injuries of the base of the skull in children than in adults.

Compression from Extravasated Blood.

Blood may be effused between the dura mater and skull, within the arachnoid cavity, underneath the arachnoid membrane, or within the substance of the brain. When compression is due to extravasated blood, the fact may, in many cases, be determined by the order of succession in the symptoms. It will be ascertained, perhaps, that the patient was at first stunned by the blow; but consciousness having quickly returned, he was able to rise and walk to his home, when, for the first, he began to experience a drowsy sensation, and soon fell into complete coma. During the period of collapse or of prostration occasioned by the injury, there was but little hæmorrhage; but, as reaction ensued, the bleeding increased, and the symptoms of compression followed

When signs of compression are present, and it is ascertained that the blow was received directly over or near the anterior inferior angle of the parietal bone, we shall have, in most cases, presumptive evidence that the great meningeal artery is ruptured, and we may with propriety employ the trephine. If, however, the blow was received at another point of the surface of the skull, we have usually no exact or approximative means of knowing the situation of the extravasated blood, and the operation of trephining can seldom, in these cases, be justified.

If the trephine is applied, and blood is not found at the point where the disk is removed, will it be proper to open the dura mater? Certainly, if there is presumptive evidence that the clot is immediately subjacent. Incision of this membrane is a grave procedure and demands deliberation; but if it is pressed forcibly into the opening, does not distinctly pulsate, and has a purplish color, it ought to be incised.

Compression from the presence of Pus, or other products of Inflammation.

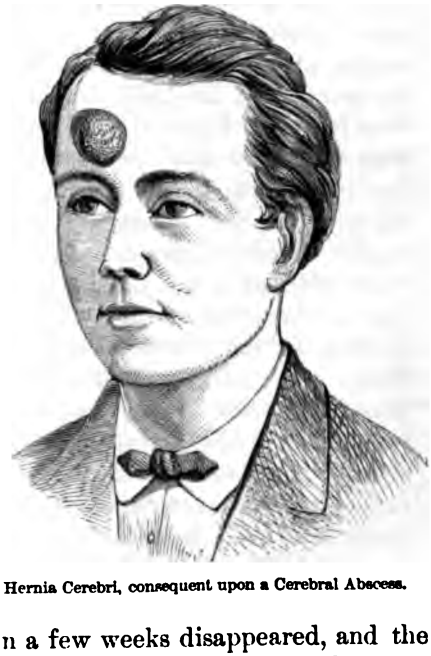
Cases are of very frequent occurrence in which there is almost conclusive evidence that compression is due to the presence of pus within the cranial walls. After an injury of the skull, of greater or less severity, the patient often recovers in a great measure from its immediate effects, and is, perhaps, able to walk about during several successive days, suffering little or no inconvenience; but at length signs of cerebral disturbance begin to manifest themselves, which gradually increase, until, at some time between the seventh and fourteenth day, possibly earlier or later, he is seized with convulsions, or with drowsiness and lassitude ending in coma. It is now apparent that the inflammatory reaction has resulted in effusion, and most probably in effusion of pus with serum and lymph. If the patient, during all this time, has experienced pain at the seat of injury, and more especially if there is a circumscribed swelling at this point, the pus has probably formed immediately underneath and between the dura mater and skull.

Generally these cases terminate fatally, whatever course of procedure may be adopted, but a few examples of recovery like the following, occurring every now and then after trephining, will continue to justify the operation in certain well-defined cases.

A lad, twelve years old, fell from a railroad car, receiving a fracture of the os frontis and of the os occipitis. Dr. Markoe, of the New York City Hospital, elevated the occipital fragment, but did not think it necessary to interfere with the fracture of the frontal bone, as it seemed to involve the outer wall of the frontal sinus. The lad recovered pletely, except that a fistulous discharge continued from the ante- wound until 1867, a period of ten years. The sinus then closed itaneously, and a few months later he had an epileptic convulsion, owed by complete coma. My colleague, Dr. Noyes, was consulted, at once decided to trephine. On removal of the bony disk no pus found, but the dura mater pressed into the aperture, and Dr. Noyes it open, giving exit to an ounce or more of pus, which operation followed by immediate relief of the cerebral symptoms. Subse- ntly a very large cerebral hernia was developed (Fig. 279), and patient, by change of residence, came under the charge of Dr. Hub- d, of Bridgeport, and myself. Under appropriate treatment, the nia was eventually cured and the wound closed; but epileptic fits tinued to recur at considerable intervals, and about three years later died in consequence of an acute attack of cerebritis.

n September, 1864, a young man was struck by a navy pistol over centre of the left frontal protuberance, causing a fracture with ht depression. No marked ebral disturbance ensued un- the twenty-first day, when, ile at work, convulsions sud- ly occurred. On the forty- ond day, he was found by s. Jones and Chinault, of hmond, Ky., in a state of found coma. Incisions were once made and the trephine lied, removing a disk of e and exposing the dura ter, which pressed up into aperture and fluctuated per- tibly. These circumstances uced the gentlemen to open dura mater freely, when re escaped about four ounces dark coagulated blood, and y offensive pus, with some tion of the substance of the in. As in the preceding e, a hernia cerebri ensued, but in a few weeks disappeared, and the und was closed. Two years later, when Dr. Chinault sent the bony k and a report of the case to me, the man remained in perfect health.

Fig. 281



Hernia Cerebri, consequent upon a Cerebral Abscess.

The two preceding cases illustrate the propriety not only of opera- g in certain cases of intra-cranial suppuration, but also of opening dura mater, whenever there is presumptive evidence that pus may found underneath.

The records of surgery furnish other similar examples;[1] and the propriety of incising the dura mater, when pus is deposited directly beneath this membrane, being thus established, it is unnecessary to defend the operation of trephining when the pus lies between the dura mater and the skull. In this case, the greater operation includes the lesser.

There is another form of intra-cranial abscess, also, in which it does not seem that there ought to be a serious doubt whether the surgeon may properly interfere. I refer to an abscess within the substance of the brain itself. In case both the skull and dura mater are laid open, and the source of the compression is not exposed, but reasonable evidence is furnished that a depot of pus lies not far from the surface, within the substance of the brain, in the absence of any observations to prove the practice unsound, can any reasons be given why the surgeon should not proceed to open the abscess? Opportunities may be rare in which such a rule could be justly applied; and chiefly because the cases may be very rare in which the diagnosis could be with sufficient accuracy made out; but surgeons have been able to recognize such opportunities, and by their successful interference have justified the practice. In this manner Dupuytren saved the life of a young man whom he had trephined for an old injury of the skull, and in whom signs of compression had supervened. Finding no pus under the point of fracture, either outside of the dura mater or in the arachnoid cavity, he penetrated the brain with his knife and discharged a large quantity of matter. Speedy relief followed, and the patient made a complete recovery. Nélaton affirms that he has repeatedly imitated the example set by Dupuytren with success. Detmold, of this city, who penetrated the substance of the brain at three different times in the same patient, was not equally successful, but the degree of relief and the delay of the fatal event afforded by the first operation vindicated the practice in that instance. Whether a more successful experience is hereafter to justify penetrating the ventricles, as was done by Detmold in his last operation, I may be permitted to entertain a doubt. It would not seem possible that the integrity of the organ could ever be restored when suppuration had invaded the ventricles, or any of those portions of the structure of the brain which lie equally remote from the surface, but I cannot say that consciousness might not be temporarily restored and death deferred. Detmold's case is substantially as follows:—

Five weeks after he had trephined a man, symptoms of compression ensued; and, having penetrated the cicatrix, including the dura mater, without finding pus, he punctured the brain, and found an abscess within half an inch of the surface. The signs of compression at once disappeared, and, notwithstanding the occurrence of a hernia cerebri, he was soon able to walk about. More than five weeks after the first operation the symptoms returned, and a second incision was made, but without giving exit to pus. Finally, two weeks later, a knife was introduced one inch and a half, and a probe passed five inches, until, as the autopsy proved, it had entered the left lateral ventricle. The patient died the same evening, and pus was found in abundance in both ventricles.[1]

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[1] Successful operation by J. F. Weeds, Surgeon U.S.A.—*Nashville Jour. Med. and Surg.*, April, 1872

Hernia Cerebri, R. C.

There are three forms or varieties of visceral protrusion from the cavity of the skull which have received the name of hernia.

The first is essentially an example of extravasation of blood into the structure of the brain, immediately beneath the pia mater. The tumor occurs soon after the receipt of the injury, forms rapidly, has a purple color, and, in most cases, ends fatally. This variety is seldom seen.

The second, is a fungoid or excessive growth of the connective tissue, with which structure, alone, lesions of the brain are repaired. It presents itself late, during the progress of cicatrization, seldom attains a very great size, and is the least liable to end in death. Its proper designation is *fungus cerebri.*

The third, and the only actual hernia cerebri, is a protrusion of the brain substance in connection, usually, with the various products of inflammation; consisting of nerve matter, mingled in varying proportions with granulation tissue, pus, etc. In most cases these herniæ occur through openings accidentally made in the dura mater; occasionally, however, they escape through openings caused by ulceration.

A true hernia cerebri is the result of pressure upon the brain; and this pressure may be caused, perhaps, by mere congestion of the intracranial vessels; but in nearly all cases it is probably due to an accumulation of the products of inflammation; or, to be more precise, it may be due to the presence of granulation tissue, or to exaggerated proliferation of reparative cell formations, to the presence of serum in the cavities, to effusions of unorganized lymph, or to the formation of abscesses.

In an analysis of sixty-five cases of cerebral herniæ collected by Dr. Robert F. Weir of this city, he observes that post-morten examinations were made in twenty-seven, and in eleven of these an abscess was found in the hemisphere corresponding to the injured side, and generally situated immediately beneath the hernia. In six of the remaining cases the ventricles were distended.[2] Dr. Gurdon Buck, in his report of thirty-three cases states that, in all in which he had an opportunity of making an examination, an abscess was found in the substance of the brain, or upon its surface in the immediate vicinity of the hernia.[3]

The **prognosis** in true hernia cerebri is exceedingly unfavorable. Of thirty-one cases reported from the New York Hospital, by Dr. Weir, only five recovered. An analysis of 107 cases of injuries of the skull, recorded by me, furnishes 7 examples of hernia cerebri; of which latter 3 recovered, 3 died, and the result of 1 is unknown.

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[1] Detmold, *Amer. Jour. Med. Sci.*, 1849. *Buffalo Med. Jour.*, Feb., 1850.

[2] Weir. Hernia Cerebri. Prize Essay. N. Y. *Jour. Med.*, Nov., 1859.

[3] Buck, N. Y. *Jour. Med.*, 1840.

Treatment of Hernia Cerebri.—In the cases reported by Weir, various plans of practice were pursued, and the results do not seem to declare for either mode a decided preference. Excision, the ligature, and caustics were followed by no special evil results; compression, also occasioned no injury beyond syncope, giddiness, and vomiting in a few of the cases. It is the general opinion, however, of surgeons that the ligature, excision, and caustics are of little or no value, or at least that these means should be reserved for exceptional cases; and that moderate pressure, and mild astringent applications, with rest, constitute the appropriate treatment in most cases. This has been almost uniformly my own practice, and the results have seemed to warrant me in recommending a similar course of procedure to other surgeons.

I believe, however, that certain herniæ cerebri may be diminished by giving exit to those collections of pus upon which the protrusion, in some cases, mainly depends. In one instance I have seen the hernia suddenly recede on the spontaneous evacuation of a cerebral abscess. In another,—the case of a man comatose and apparently about to die from compression,—having myself pushed a probe into the brain to the depth of one or two inches beneath a hernial protrusion, no matter escaped. Death occurred on the following day, and the autopsy disclosed an abscess, into which the instrument had fairly penetrated. If a trocar and canula had been substituted for the probe, there is every reason to believe that the abscess would have been evacuated and my patient, at least temporarily, relieved.

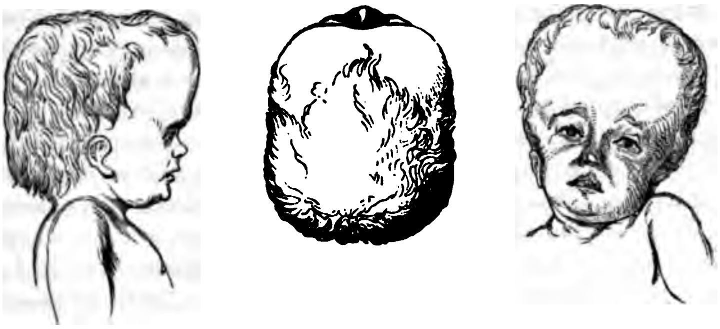
SECTION 5.—HYDROCEPHALUS, R. O.

Of hydrocephalus there are two varieties mentioned by medical and surgical writers, namely, the acute and the chronic.

Acute Hydrocephalus is generally a result of meningitis, and is more properly considered in treatises upon the practice of medicine. It may be sufficient here to say that mercurials, the acetate and nitrate of potassa, and iodide of potassium, especially the latter in minute doses, have obtained the most reputation for the relief of this form of hydrocephalus. Surgical expedients have almost uniformly proved unsuccessful, or have only hastened the fatal issue. The general prognosis is, however, not so unfavorable as in the following variety.

Chronic Hydrocephalus is usually a congenital affection, and does not seem, at least in most cases, to depend upon any degree of inflammatory action. The fluid is found either in the ventricular spaces, in which examples the convolutions become unfolded and expanded; or it may consist only of serous effusions into the subarachnoid cavity. Finally, serous effusions may exist in all these cavities at the same time; and probably such is the fact in the majority of cases. The brain itself may be normal in quantity, it may be in a condition of hypertrophy, or of atrophy. The cranial bones are usually hypertrophied, or at least greatly expanded, but the fontanelles are generally unusually large. If the child survives a few years, the effusion in most cases continues to increase, and the cranial bones to expand until the head has attained an enormous size.

Fig. 282.



Chronic Hydrocephalus.

Sometimes the fluid, both in cases of internal and external hydrocephalus, forms a tumor, or an elongated pouch at the fontanelles. If the fluid is deposited in the ventricles (internal hydrocephalus), the tumor probably contains cerebral substance as well as serum. This is called an **encephalocele.** If the arachnoid cavity alone is occupied by the effusion, the tumor will contain serum only, and it has been named **meningocele.** (See Tumors of the Scalp.) In 1849, Mr. Braithil brought to me a child two weeks old, with two of these tumors upon its head; one, having a very small pedicle, situated at the posterior fontanelle, and a second, of the size of an orange, at the posterior inferior angle of one of the parietal bones.

Treatment of Chronic Hydrocephalus.—There is not much reason to suppose that either internal or external therapeutics ever effect a cure of this malady, certainly not when, as is usually the case, it is congenital. Children have indeed, in a few cases, survived many years with enormous hydropic heads, and in one case reported by Maréchal, death did not take place until the seventieth year of life. Moreover, the effusion has perhaps sometimes disappeared, and complete recovery ensued, but there is no evidence that this result was ever accomplished by therapeutical measures.

What better expedients can the surgeon offer? Compression is, in my opinion, subject to the same judgment as therapeutics. Of tapping, with or without compression, one must speak more guardedly, and chiefly because it has set up for itself more pretension. According to Gross, Dr. Vose, of New York, was the first to suggest this operation; but what has, probably, more than anything else influenced surgeons to make trial of tapping, was the remarkable statement made by Dr. Conquest, in 1838, that he had by this method cured ten out of nineteen cases. Dr. West has also collected sixty-three cases of tapping, of which eighteen are reported cured.

I have myself operated upon two cases; a report of one of which was published in the American Journal of Medical Science for February, 1837, with a full account of the appearances disclosed in the autopsy. Both of my patients died within three or four days after the operations were made; death in each instance being preceded by convulsions.

Several of my friends, in this city and elsewhere, have made the same operation, but in no case, so far as I have been able to learn, have they been successful; and when we consider that in most of these examples the brain has suffered a complete evolution or unfolding, or that it is atrophied, hypertrophied, or otherwise disturbed and disorganized; that the bones, also, are so greatly expanded or hypertrophied, that the removal of the fluid must leave the brain without support, [illegible] would certainly seem that nothing less than a failure could ordinarily be expected. We have often seen in children moderate arachnoid effusions following severe injuries, which have disappeared spontaneously; or which we might, even if excessive, reasonably hope to benefit by tapping, inasmuch as neither the brain nor its investments have undergone any serious structural changes; but observations made upon this class of cases have no application to chronic, congenital hydrocephalus.

In case, however, the surgeon were to operate, the puncture should be made with a very small trocar and canula, in the anterior fontanelle, but at some distance from the median line, so as to avoid the superior longitudinal sinus. Only a few ounces, at most, should be withdrawn at first, although Conquest tapped much more boldly; and the operation must be repeated from time to time, the head, meanwhile, being constantly supported and compressed by an elastic cap, by bandages or by adhesive strips.

CHAPTER II.

SURGERY OF THE EYE, AND ITS APPENDAGES.

Congenital Malformations.—The following constitute the principal congenital malformations to which the eyes and their appendages are subject:—Total absence of both eyes; absence of one only, the other occupying its normal position; fusion of the two eyes in one, in which se the eye is more or less central (cyclopia); eyes small (mikrophthal- os); absence of iris; absence of eyelids; cleft upper lid; cleft choroid d iris (coloboma iridis); closure of the eyelids (atresia palpebrarum; nchyloblepharon); adhesion of the lids to the ball (symblepharon); bnormal narrowing of the palpebral fissure (blepharo-phimosis).

Diseases of the Eyelids.

Cystic Tumors of the Eyelids.—I have observed two forms of encysted tumors upon the lids, which seem to demand a special mention in this connection.

Cystic tumors caused by obstruction and dilatation of the acini of the Meibomian glands; seen most frequently in youth or in middle age, and more often upon the upper than upon the lower lid. They may present themselves upon the outer or upon the inner surface of the lids; but in most cases they are external, and, in a large majority of cases, they are situated remote from the tarsal margin. In size they seldom exceed one-quarter or one-half an inch in their longest diameter; and, when external, they are usually oval in shape, elastic, without color, and the skin moves freely over them. They sometimes recede and disappear spontaneously.

The treatment is free incision, parallel to the fibres of the orbicularis palpebrarum. The mobility of the tissues is such, that it is difficult to dissect them out without mutilating the tarsal cartilage from which they have emerged, and experience has convinced me, that it is sufficient to open them freely, and press out the contents. After a few months no trace of a cicatrix is usually left.

When one of the acini lying nearest the palpebral surface is involved, and the tumor presents underneath the lid, the subjacent conjunctival surface is vascular, and sometimes becomes perforated, the tumor appearing covered with granulations. Incision from the conjunctival surface will here, also, in most cases insure a cure.

Cystic tumors caused by obstruction and dilatation of the sebaceous and hair follicles of the lids (not in the Meibomian glands). These occur more frequently in advanced life, and equally upon the upper and lower lids. They do not attain so great a size as do the acini of the tarsal glands; being seldom larger than a pea. They are round; the overlying integument is not always movable, and generally, when near the surface, they have a yellowish white or pearly appearance.

The surgical treatment, if any should be required, may be the same as for the preceding variety, namely, excision or incision, as the surgeon may find most convenient.

Congenital Encysted Tumors, occurring upon the External Angle of the Eyebrow.—There is a class of encysted tumors, mostly and perhaps always congenital, which do not form in the *interior* of sebaceous follicles, and some of which have no apparent relation to these follicles; but which possess many points in common with the tumors now under consideration, and such as will render it proper to speak of them in this connection. Their most frequent seat is upon, or beneath the outer extremity of the superciliary ridge, where they are found lying directly upon the periosteum, causing a marked depression of the bone. Most frequently I have been consulted when they were half or three-quarters of an inch in length in their longest diameter being of an oval form, elastic, and without pain, tenderness, or discoloration. These cysts are lined with a perfect epithelial membrane, and frequently several undetached hairs will be found projecting from the hair follicles which cover their interior surfaces, the remaining contents resembling what is usually found in obstructed sebaceous follicles. It is probable that these tumors are due to an accidental involution or doubling in of the derma, occurring during the process of growth in fœtal life. Similar cysts—probably of dissimilar origin—have been found within the skull, under the tongue, in the lungs, kidney, bladder, testicles, etc.; but the most remarkable examples are found in the ovaries, in which the cysts have been seen to contain not only hair, but also rudimentary teeth and brain substance.

In the case of the congenital supra-orbital tumor, of which alone we propose now to speak, the treatment consists in excision of the entire sac. If the tumor is not removed before adult life, the cup-like depression in the bone will generally be such as to leave a manifest and permanent deformity.

In addition to the tumors above described as occurring upon the lids, or in their immediate vicinity, it is proper to mention that we occasionally meet with fibroid and fibroid recurrent tumors, which have their origin upon the tarsal margins; and encephalomata are not unfrequently seen originating from the lower or upper lid, especially from the latter.

Stye. Syn., Hordeolum, R. C.—An acute inflammation of the duct, or of one of the acini of a Meibomian gland, ending, usually, in suppuration.

Attention to the general health, and early evacuation of the contents of the sac, constitute the essential points of treatment. They may sometimes be aborted by extracting the cilia situated upon the stye, or by the application of the tincture of iodine; when the pus is not evacuated spontaneously, or by incision, a small, hard tumor usually remains after the inflammation subsides, called a *chalazion*. If one of the acini remote from the tarsal margin is the seat of this induration, containing the débris of pus, etc., it assumes the form, and may in fact constitute, one of the varieties of the encysted tumors already described.

Chronic Inflammation of the Tarsal Margins. Syn., Ophthalmia Tarsi, R. C.; Blepharitis Ciliaris.—A chronic inflammation of the tarsal margins, involving usually the ciliary hair follicles, and their accompanying glands, or the Meibomian glands (the **blepharo-tarsalis**

of Stellwag), or both, and causing a copious secretion which, during sleep, glues the lids together.

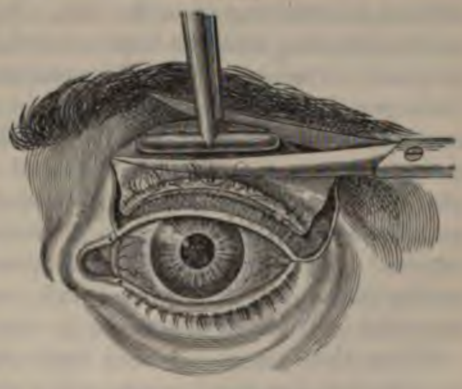
The proper treatment of this affection consists in the adoption of measures for the improvement of the health, frequent ablutions with tepid water, and in the application to the outer margins of the lids, at bedtime, of an ointment composed of ung. hyd. oxid. rub. ʒ j., axung. ℥ iij., or of dilute citrine ointment.

Inversion of the Cilia. Syn., Trichiasis, R. C.—This condition may be relieved by extraction of the hairs. In some few cases, also, repeated extraction results in atrophy of the follicular glands, and the cilia being no longer reproduced, a permanent cure is effected. If this expedient fails, it has been recommended to practise transplantation of the cilia, by splitting the lid from its tarsal margin, removing a crescentic piece of integument above, and sliding up all that intervening portion which contains the cilia and their glands; but beside that the intercepted narrow strip is liable to slough, the method is subject to other objections and is now seldom practised.

The method above described has been modified, also, in the manner represented in the accompanying wood-cut, by uniting vertical incisions with the two extremities of the horizontal slit, sliding the integument up and then removing a small elliptical piece of integument. In this way the danger of sloughing is avoided; but Stellwag prefers complete excision of the hair follicles to either of the two preceding methods. Others have advised destruction of each separate follicle by heated iron points, by caustics, or by setons.

The fact is, however, that, as Stellwag candidly admits, all of these methods have their serious disadvantages, the operations often resulting in deformities and defects more grave than those which it was proposed to remedy. If, therefore, anything is to be done beyond the occasional extraction of the cilia, it must be to resort to some one of those expedients hereafter to be recommended for the cure of entropion.

Fig. 283.



Graefe's Operation for Trichiasis.

True Distichiasis is in most cases a congenital abnormity, and does not usually require surgical interference; but when the cilia arrange themselves in double rows in consequence of chronic blepharitis ciliaris or other tarsal diseases, and irritate the conjunctiva, the treatment must be the same as for trichiasis.

Inversion of the Lids. Syn., Entropion, R. O.—Entropion may be due to a contraction of the orbicular muscle alone; or to a contraction of this muscle, the inversion being favored by atrophy of the cartilage, and a consequent rounding off of the inner tarsal margin, or by cicatrization and contraction of the tarsal margin and conjunctiva.

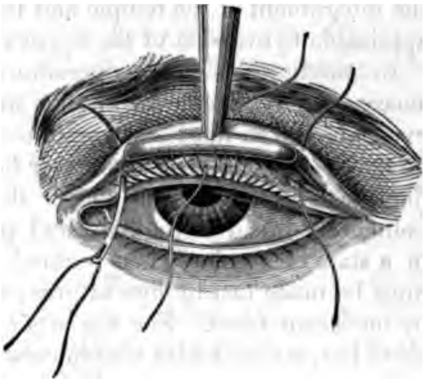
When it is due to spasmodic contraction of the muscle, as may happen in any of those forms of ophthalmia which are accompanied with photophobia, no surgical interference is generally demanded. It has been suggested, however, that in certain very intractable cases it may be proper to make the operation of *canthoplasty;* dividing the external portion of the orbicularis by an incision, commencing at the external canthus and extending obliquely upwards and outwards, or downwards and outwards, according as it may be the upper or lower lid which is affected. The same result may be attained temporarily by strips of adhesive plaster, or by enclosing a fold of integument in serrated and flattened forceps constructed upon the self-sustaining principle of *serres-fines.*

When entropion exists in some measure independent of the action of the muscle, as happens in the majority of cases, canthoplasty may be combined with excision of a portion of the palpebral integument, or excision alone may be practised; but in order that excision may prove successful, it will be necessary to remove a large portion of the integument of the lid by double elliptical incisions. In the case of the upper lid the operation is as follows: First, an incision is made the entire length of the lid, and as close to the tarsal margin as possible without encroaching upon the cilia. Second, an incision, commencing and terminating with the first, is carried—in the centre of its line of elliptical curve—to within about one-half or one-quarter of an inch of the supercilia. Third, the intercepted integument is seized with delicate mouse-tooth forceps and dissected from the orbicular muscle. The accidental removal of a few fibres of the orbicularis is of no consequence, yet with care it may be avoided. Fourth, the margins of the wound are closed from above downwards, by a number of fine silk sutures. In this part of the operation the surgeon will be aided by seizing the edges of the wound with mouse-tooth forceps, and pressing the point of the needle through the tissues into a piece of cork.

When the operation is well made, the patient will not be able to close his lids completely; but, such is the elasticity of these tissues, that in a few weeks they will close perfectly, even during sleep. It will now be observed that when the lids are open, no disfigurement of the upper lid will be apparent, and some degree of entropion will remain; but on closing them, the upper lid will be found to have lost its natural range being in a state of moderate tension, and the tarsal margin will be everted. I have made this operation many times, and never without affording permanent relief to my patients.

The accompanying wood-cut illustrates the same operation made with the aid of a crutch-shaped forceps; the sutures being introduced before the elliptical piece of integument is excised. This method is preferred by some surgeons; but the sutures are apt to be cut in making the incisions; and it will oftener happen that an insufficient amount of integument is removed, than when the method just described is adopted.

Fig. 284.

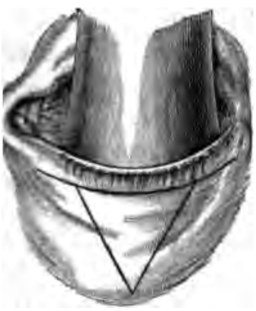


Operation for Relief of Entropion of the Upper Lid.

Invagination of the integument by ligatures, recommended by Pagenstecher, Gaillard, and others, is successful only so long as the inflammatory adhesions remain. The principle is faulty, as it has again and again been proved to be, when applied, also, to the radical cure of hernia and of prolapsus uteri.

Bowman's plan of subcutaneous ligature of the orbicularis has not sufficient merit to entitle t to a description. Graefe's method of removing a triangular piece of integument, with its base resting upon the tarsal margin, and Busch's modification of the same, in selecting a point external to the outer canthus for the operation, are worthy of trial in cases of entropion of the lower lid, but not of the upper. In both of these latter operations the wound is closed by sliding the integument from opposite sides and parallel to the tarsal margin, and securing it in place by sutures.

Fig. 285.



Graefe's Operation for Entropion.

Eversion of the Lids. Syn., Ectropion, R. O.—Eversion of the lids may be due to paresis, atrophy, or to unequal action of the orbicular muscle, to inflammatory softening and hypertrophy of the tarsal cartilages, to hypertrophy and trachoma of the palpebral conjunctiva, to a shrivelling of the derma, to ounds, loss of tegumentary tissue, and to the cicatrices of burns, etc.

When the eversion is moderate but persistent, it may be remedied by emoving a triangular piece of integument beyond the outer canthus, he base of the triangle resting upon the upper and lower tarsal margins, and then closing the wound by vertical sutures.

Greater degrees of eversion of the lower lid will be relieved by a **V**-aped incision below the centre of the tarsus, the base being directed oward the tarsal margin; and by sliding the intercepted triangle of ntegument upwards. To be effective the base should include a large ortion of the lid, and the apex should be prolonged well down upon

Canthoplasty, if practised for the purpose of relieving the spasm of e orbicular muscle, will be made as directed when considering the reatment of entropion; but if the purpose is to enlarge the commis- ure, as may become necessary in cases of anchyloblepharon, of blepharophimosis, or of blepharostenosis, the incision must be made horizontally, and the opposing edges of integument and mucous membrane require to be united by sutures, to prevent reunion.

Blepharophimosis, is the name given by Ammon to congenita shortening of the palpebral fissure; while the term **blepharostenosis** is applied to the same condition when it occurs later in life. In either case there is usually an atrophy and shortening of the palpebral cartilages in their transverse diameter. Canthoplasty is the only remedy.

Diseases of the Lachrymal Sac and Canals.

Dacryocistitis.—Inflammation of the lachrymal sac, when acute, is recognized by a tense, red, shining tumefaction situated at and below the inner canthus. Unless arrested, the inflammation ends speedily in suppuration and perforation of the walls, the pus, in most cases, making its way pretty directly to the surface through the integument.

It should be treated by cool lotions, rest, and general antiphlogistics; and as soon as pus has formed, the sac should be opened by introducing a knife about two lines internal to the commissure and on a level with the border of the lower lid, the point of the knife being directed downwards and outwards.

Some surgeons have recommended that, in order to prevent perforation and the formation of a fistula, the lower canaliculus should be slit up at an early period of the formation of pus.

Dacryocisto-blennorrhœa, is a chronic form of inflammation pertaining to the lachrymal sac and its appendages, seen especially in scorbutic patients. It is characterized, eventually, by a circumscribed, colorless, and painless tumor in the situation of the lachrymal sac; a result of thickening of the walls of the canal, and consequent obstruction, with accumulation of tears, mucus, and pus. At first, and for some time, the sac may be emptied by pressure, the contents being evacuated through the puncta lachrymalia or nasal duct. When the obstruction has continued many months or years it generally results, like acute inflammation of the sac, in the formation of a fistulous opening. Lachrymal calculi (dacryoliths) and polypi have occasionally been found in the sac.

Chronic thickening of the lachrymal canals yields, in many cases, to well-directed constitutional remedies, among which improved nutrition, exposure to air and light, and tonics take the first rank. In this, as in all other chronic catarrhal affections, local measures and surgical expedients should be held second and subsidiary to general hygiene. In the event, however, of the failure of these latter measures, the next most proper expedient is dilatation by bougies or probes. If a fistulous canal exists, communicating with the sac, the instrument may at first be conveyed into the nasal duct through the fistulous orifice; but as the constant introduction through this channel will prevent the closure of the fistula, after a time, the probes should be passed by the canaliculi. Bowman's graduated probes of malleable metal, of ivory or horn, are now much in use; but Dr. Williams, of Boston, believes that he has improved these probes by diminishing their diameter near the bulbous extremity, which modification increases their adaptability to the tortuous canals through which they have to pass.

The introduction of a probe demands great delicacy of manipulation If the upper canaliculus is chosen, the lid is first drawn a little outwards, when the point of the instrument is introduced into the punctum in a direction almost vertical; it is then carried horizontally inwards and finally downwards into the sac. In order to pass from the sac through the nasal duct, the probe must be directed downwards with a slight inclination backwards and outwards. If the probe is nearly or quite inflexible, and the point has entered the inferior nares, the upper portion should rest lightly against the supra-orbital notch. Its presence in the nose may be demonstrated by exploration of the nares with a common probe. Most oculists to-day prefer to slit up the canaliculus before introducing the probe; which is done by introducing Weber's narrow probe-pointed knife into the punctum and extending the incision to the sac.

At first the probe should be permitted to remain only a few seconds, and the smallest size should be chosen; but as the tolerance of the canal increases it should be permitted to remain longer, and the size of the instrument should be increased. Some surgeons prefer catgut bougies, which can be permitted to remain longer; and Dr. Williams has lately recommended leaden bougies on account of their greater flexibility.

Dupuytren's silver tubes, intended to be buried in the sac, and solid silver styles introduced through fistulous or artificial openings on the surface of the integument, are now seldom or never employed. Frequent probing, with syringing, and the occasional introduction of a leaden style, or of a catgut bougie, which may be permitted to rest a few days in the direct opening made by incision of the canaliculus, constitute the chief surgical expedients of oculists to-day. Bougieism and catheterism from the nose, destruction of the sac, and removal of the lachrymal gland, are nearly obsolete practices.

Diseases of the Conjunctiva.

Inflammation of the Conjunctival Membrane. Syn., Inflammatio Conjunctivæ, R.C.; Ophthalmia.—The term "ophthalmia" properly comprehends all inflammatory affections of the eye, but it is seldom employed in this general sense, being restricted usually to inflammations originating in, and mainly confined to the conjunctival membrane.

Catarrhal Conjunctivitis. Syn., Ophthalmia cum Catarrho, R. C—Catarrhal conjunctivitis may exist upon that portion of the conjunctiva which lines the lids, and is then termed **palpebral conjunctivitis** or **blepharitis**; it may be limited to the ocular portion of the membrane,—**ocular conjunctivitis**; or it may invade both portions simultaneously or consecutively.

Catarrhal conjunctivitis is characterized by vascularity of the membrane—and, in the case of ocular catarrhal conjunctivitis, the vascularity is most intense toward the outer and inner canthus—by a sensation as if particles of sand were beneath the lids; by heat, pain, intolerance of light, lachrymation, secretion of mucus, and, in the higher grades of the inflammation, by secretion of pus.

The treatment is first, general—a single brisk cathartic, low diet, and rest; second, local—exclusion from light, air, and dust, the application of cool water lotions to the lids; and, after a time, the use of mild astringent collyria, such as sulphate of zinc, one-quarter of a grain to the ounce of water, or nitrate of silver, one-eighth of a grain to the ounce.

Purulent Conjunctivitis. Syn., Ophthalmia Purulenta, R. C.—Like catarrhal conjunctivitis, this form of conjunctivitis may affect either portion of the conjunctival membrane primarily, but it is seldom if ever limited to one portion exclusively. Purulent conjunctivitis is characterized by more intense and rapid inflammation, and by an aggravation of all the phenomena usually appertaining to the catarrhal form. The submucous tissue speedily becomes infiltrated and swollen, and pus is poured out in great abundance. Its active stage is usually short, but in the mean time it often happens that the cornea is penetrated, or rendered permanently opaque, and vision is impaired or lost entirely.

Occasionally, no doubt, purulent conjunctivitis originates in the adult spontaneously, or from ordinary local irritations, but such examples are rare. In a vast majority of cases it is occasioned by inoculation, the matter being conveyed from some person suffering under purulent ophthalmia, or from the urethral or vaginal secretions in gonorrhœa; or it has occurred, perhaps from vaginal secretions also, in children newly born. Surgeons have therefore usually mentioned only three forms of this malady, namely; **contagious** or **purulent ophthalmia, gonorrhœal ophthalmia** and **ophthalmia neonatorum.** The first of these, from the fact of its being endemic in Egypt, is known as **Egyptian ophthalmia.** The treatment of traumatic or accidental purulent ophthalmia, and of Egyptian ophthalmia, is essentially the same as that which will presently be directed for gonorrhœal ophthalmia.

Gonorrhœal Ophthalmia. Syn., Ophthalmia Gonorrhoica, R. C.—Of all the forms of ophthalmia, that which is caused by the inoculation of gonorrhœal virus has generally proved the most violent, rapid, and destructive; and I do not think it is too much to say, that in a majority of these cases vision will be destroyed, no matter what plan of treatment is adopted.

The remedies upon which I have been disposed to place the most reliance are: first, one active cathartic, the chief value of which consists in its revellent effects; second, moderate diet, exclusion from light, rest in the half-recumbent position and with the head reclining upon the side opposite to the affected eye; third, collyria of nitrate of silver of the strength of from one to two grains to the ounce of water, applied twice daily, and the application to the lids and forehead of thin muslin cloths moistened with tepid water in the intervals; fourth, repeated and thorough cleansing of the eye with tepid water, but not with a syringe, which generally causes irritation more than commensurate with the good it accomplishes; fifth, scarification and cupping of the temples; sixth, one or two free incisions of such portions of the intensely swollen conjunctival surface as can be easily reached. Great care must be taken to protect the opposite eye from inoculation, and to prevent the conveyance of the virus to the eyes of the attendants.

Ophthalmia of Newly Born Children. Syn., Ophthalmia Infantium Purulenta, R.C.; Ophthalmia Neonatorum; appears usually within from two to three weeks after birth, and often much sooner.

The causes of this affection have been much discussed, and from all that has been observed it must be concluded that it originates from various sources, as for example the inoculation of vaginal secretions, such as leucorrhœa, menstrual fluids, etc.; from rude washing with soaps, cloths, and sponges in the hands of the nurse; from exposure of the eyes to strong light, and from colds. Over-crowding, imperfect ventilation, and the strumous diathesis, are also active predisposing causes. Conveyance of the virus from one child to another, and from one eye to the other, must also be enumerated among the specific causes.

Although this affection is usually classed as purulent, yet there are many cases in which the inflammation is mild, transient, and more properly catarrhal. Such, however, is the laxity of the infantile textures, that effusions occur speedily in nearly all cases, and even in mild cases there is great swelling of the lids and of the subconjunctival structures.

Cleanliness, good nourishment, the application of muslin cloths moistened with tepid water, and mild astringent collyria, have never failed, in my experience, to bring the inflammation to a close within from one to three or four weeks, and without any permanent impairment of vision. Simple rose-water is often sufficiently active, or with the addition of one grain of the sulphate of zinc to three or four ounces of the water. Nitrate of silver is an agent of too much energy to be employed upon tissues so young and delicate, and I have more than once seen the eye destroyed by its use in these cases.

Membranous Conjunctivitis seldom appears as a primary affection, but in the majority of cases as an episode to catarrhal or purulent conjunctivitis, or as the transition stage merging into diphtheritic conjunctivitis. As its name implies, it is characterized by the deposit of more or less fibrinous material upon the surface of the conjunctiva, which, however, usually falls off in shreds or in masses. The membrane rarely if ever extends over the cornea, so that the cornea appears depressed, constituting a variety of **chemosis**; a term generally employed, however, to denote an elevation of the sclerotic conjunctiva, chiefly as a consequence of effusions of serum, while the corneal conjunctiva preserves its natural level. By some writers the term chemosis has been employed to designate a considerable swelling or elevation of any portion of the conjunctiva, including the palpebral conjunctiva, and which is the result of inflammatory effusions.

No new and special indications of treatment are presented in these cases, except that the occurrence of adhesions is to be prevented, and the shreds of membrane are to be carefully removed as they become loosened. It may be proper, however, to observe, that in the œdematous variety of chemosis it is prudent, sometimes, to incise the conjunctiva to prevent strangulation of the cornea, but this practice is not recommended in membranous chemosis.

Diphtheritic Conjunctivitis, like the preceding variety, may interchange with catarrhal or purulent ophthalmia, or it may occur as an original affection. It has many points in common with membranous conjunctivitis, but it is more destructive, and the false membrane usually deliquesces, and does not fall off in patches. In common with all the other severe forms of conjunctivitis, it is contagious.

The local treatment is essentially the same as in other forms of ophthalmia; but no highly astringent or caustic applications are ever proper. In relation to the constitutional treatment, it must be remembered that diphtheritic neoplasms always imply blood-poisoning, or at least a condition of the system closely allied to that induced by blood-poisoning, and nothing else than a sustaining plan can prove useful.

Granular Conjunctivitis. Syn., Trachoma, can scarcely be regarded as a distinct variety of conjunctivitis, being almost always a result or concomitant of some one of the catarrhal or purulent varieties already described. It consists essentially in hypertrophy of the papillæ of the palpebral conjunctiva, and in the formation of additional vascular excrescences, giving to the inner surface of the lids at first a velvety, and subsequently a rugose, seamed, and warty appearance.

The general treatment will be indicated by the condition of the patient. In most cases these patients are pale and anæmic. The best local application is sulphate of copper, applied by passing the solid stick across the granulations, and then immediately bathing the surface, before the lid is allowed to resume its position, with a little sweet oil.

Phlyctenular Conjunctivitis. Syn., Herpes of the Conjunctiva. This affection is characterized by small serous vesicles which arise from minute points of inflammation in the structure of the conjunctiva, ending, usually, in rupture and the formation of small superficial ulcers. The phlyctenulæ occur most frequently over the cornea, near its outer margin, but they are often seen in the sclerotic conjunctiva, and not unfrequently upon other portions of the conjunctiva surface.

The affection has seemed to the author almost peculiar to strumous, bed-ridden, feeble and anæmic patients. The existence of the vesicles is generally brief, usually not longer than six or eight days, and when they occur over the cornea they render the conjunctiva slightly nebulous. The treatment should be directed primarily to the improvement of the general health. One or two applications of a solution of nitrate of silver—one grain to the ounce of water—will often disperse them, at least temporarily.

Xerophthalmia. Syn., Xerosis of the Conjunctiva.—As a consequence of some of the various forms of conjunctivitis enumerated, or from other causes, the conjunctiva occasionally undergoes a peculiar tendinous or cicatricial degeneration and shrinkage; losing its transparency, becoming thickened, tense, dry, and white or straw-colored. As the contraction of the conjunctiva progresses, also, the semilunar folds become obliterated and the lids restricted in their motions.

This condition is incurable, but the sense of discomfort it occasions may be alleviated by frequent pencilling with glycerine.

Falling of the Upper Lid. Syn., Ptosis.

The upper lids are sometimes observed to droop or fall, constituting the condition called ptosis. This affection occurs; first, as a congenital affection, of which I have seen several examples, and in one it was hereditary; second, as a result of paresis, or of paralysis; third, in consequence of the presence of granulations and tumefaction of the upper lids; fourth, as a result of inflammation which has terminated, but which has left a temporary or permanent anchylosis, atrophy, or degeneration of the levator palpebræ.

In the last two forms of this affection something may be hoped from lapse of time and from therapeutical treatment, but in congenital and paralytic ptosis, nothing but a surgical operation can afford relief. I would, however, never advise an operation where the lid can be voluntarily lifted a line or two above the equator of the eye, since the operation itself seldom accomplishes more than this without causing lagophthalmos, a permanent inability to close the lids.

The operation usually made for the relief of ptosis consists in the removal of a large portion, probably three-fourths, of the integument of the upper lid, by double elliptical incisions; in short, it is the same operation as that already described for entropion of the upper lid.

Strabismus R. C. Syn., Cross-Eye; Squint-Eye.

Definition and Varieties.—Strabismus is a loss of parallelism in the axes of the two eyes, or, more properly speaking, a loss of correspondence in the visual axes. It is occasionally congenital, but in a large majority of cases it is acquired. In an analysis of sixty-one cases upon which I had myself operated prior to 1845, four were believed to be congenital.[1] The eye may be fixed immovably in its abnormal position, or it may have a limited range of motion. The one is called **immobilis** or **luscitas**, and the latter **mobilis.**

It is convenient, also, to divide strabismus, according to the degree of deviation, into the first, second, and third degrees, allowing 15° of the circle to each degree of deviation. The muscles of one eye may be affected, or of both, or they may be affected alternately. Strabismus may be occasional, intermittent, periodical, or permanent. In most cases the strabismic eye is turned inwards, constituting strabismus internus, or convergens. The other varieties, depending upon the direction of the deviation, occur in the following order of frequency; divergens, attollens, depressens, obliquens. Of the oblique forms, upwards and inwards is the most frequent.

Rules governing Operations.—The following circumstances and conditions contraindicate an operation:—First, when the strabismus is recent, occasional, periodic, or at one time convergent and at another divergent; when the eye is turned less than the first degree. In either of the above cases section of the muscle is likely to cause an opposite deviation;—Second, when there is complete paralysis of a muscle—a fact which may be determined by the history and concurrent symptoms, and by directing the patient, having his sound eye closed, to turn the eye out, which he will be unable to comply with; nor, in making the effort, will he experience any sensation as of strain or resistance at the inner canthus;—Third, when strabismus is due to extensive lesions and consequent adhesions—I have found that in such cases the dissections have to be extensive, and that the chance of failure, from the general impossibility of cutting every small band, is very great, while the deformity left by the incision is greater than that caused by the strabismus:—Fourth, when caused by opacity of some portion of the cornea a correction of the deviation would impair vision;—Fifth, if the eye is turned decidedly in either of the diagonals, I have never seen an operation restore perfectly the visual axes;—Sixth, when the eyes are naturally very prominent—since in these cases the slightest recession of the conjunctival fold, and advance of the ball in consequence of the section of the muscle, gives to the eye a staring look. We have seen many "wall eyes" caused by strabotomy, in such cases as these, which were ugly deformities as compared with the previous strabismus;—Seventh, if the patient is younger than ten years—because in not a few of these cases the strabismus disappears spontaneously; and because experience shows that operations in childhood are more apt to be followed by recurrence;—Eighth, if the patient is over fifty—since, at this period of life, it is only as a means of restoring harmony to the features, and not as a means of improving vision, that we usually operate. Moreover, when the strabismus has existed from infancy to old age, the power of the elongated muscle to rectify the deviation, when its antagonist is cut, is, in most cases, almost or completely lost.

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[1] Monograph on Strabismus, by the author, 1845.

Operation of Strabotomy.—As a rule I have not thought it necessary to place the patient under the influence of an anæsthetic in making the operation of strabotomy. The instruments required are a pair of probe-pointed scissors; delicate mouse-tooth forceps; and a firm hook sustained by a handle, its point being probed, but sufficiently flattened that it may pass readily under the tendon.

The patient, if not anæsthetized, should be seated facing a good light, on a chair of such height that the eyes shall come opposite the eyes of the operator. An assistant, standing behind the patient, steadies the head, and elevates with his fingers the upper lid; while the operator, seated in front, takes, in all cases, the forceps in his left hand, the scissors in his right, with the little finger of his left hand resting upon the lower lid, and, at the same time depressing it, directs the patient, in a case of convergent strabismus, to look steadily outwards: at this moment the surgeon seizes the conjunctiva, about three or four lines from the margin of the cornea, and one line below the horizontal axis of the eye, and with the scissors divides it in a perpendicular direction. The probe-pointed hook is now carried beneath the tendon, and its handle depressed across the bridge of the nose, in order that its point may emerge easily from between the lids. With the scissors, the tendon is at once severed—in case we are operating for a strabismus of the first or second degree—on that side of the hook which is nearest the attachment of the tendon; but, in case of a strabismus of a third or fourth degree, the muscle itself must be divided, the scissors being applied on the side of the hook in the direction of the origin of the muscle. If now the eye does not, after a moment of rest, resume its normal position, and it is certain that the entire tendon or muscle is divided, the capsule of Tenon must be cut upwards and downwards freely by the scissors introduced beneath the conjunctiva.

However much others may choose to complicate this operation, by assistants, specula, hooks, tenacula, knives, etc., I have always found the above-described simple method the most convenient and adequate.

If, within a few minutes at most, the eye does not become straight, I cannot agree with some surgeons in saying, that there is much probability that it will be restored after the lapse of a longer time. There has been a slight subsequent improvement in a small proportion of cases under my observation, but such examples are rare. Nevertheless, if there is any considerable change in the position of the eye, although the parallelism of the two eyes may not be complete, it is not advisable to proceed at once to cut the tendon of the opposite eye, since by so doing there is much danger of causing a divergence. Tenotomy upon the opposite eye, under these circumstances, should be reserved for consideration at a later period. The expedient suggested by Graefe, of seizing the divided tendon with a ligature and securing it over the opposite angle of the eye, is said to have succeeded in similar cases, but I have not tried it. It has appeared to me best always to desist at this point. Vertigo following the operation is usually of short duration. Double vision may, however, continue many days or even weeks.

The subsequent management is very simple. A few days' detention within doors may or may not be necessary; possibly cool water lotions will be required. Experience also has taught us that both eyes should in general be permitted to remain open after the operation; but that, if either eye is closed, it should be the sound eye, while the patient practises turning the strabismic eye outwards. When the eye operated upon is closed it is in more danger of turning in and of becoming again strabismic. If, after an operation, strabismus is reproduced, it is generally between the second and third weeks, during the period when adhesion and cicatrization are being consummated.

After the lapse of a few days, a small fungous granulation often appears at the seat of the wound, which soon attains the size of a pea. It may be removed with the scissors, or, if permitted to remain, it will either retire spontaneously, or eventually become constricted at its base, assuming the form of a small, pediculated polypus, and then fall off spontaneously.

Foreign Bodies in the Eyes.

Spicula of iron, and other sharp and minute bodies, embedded in the conjunctiva, will generally loosen and detach themselves within two or three days; but they ought to be removed earlier, if practicable, with the point of a cataract needle. They are more often found over the cornea than elsewhere, but, if situated deeper within the folds of the lids, they may be discovered by everting or simply lifting the lids. When cinders or scales of iron have become thus lodged, even for a short time, a brown stain is usually left after their removal, which generally disappears as the wound cicatrizes.

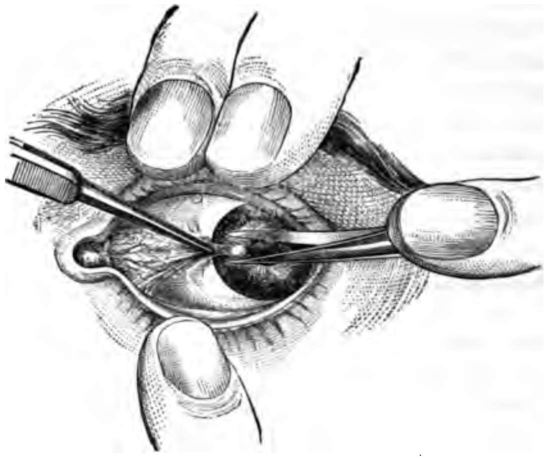
In case the foreign body has perforated the cornea, and is within sight, no time ought to be lost in its removal. The pupil having been well opened by atropine, the patient should be anæsthetized and a sufficient corneal section made to enable the operator to seize and extract the body by the aid of delicate forceps. If permitted to remain, the destruction of the eye is almost inevitable. If it has penetrated the lens, the lens should be extracted.

Pterygium. Syn., Unguis, R. C.

A pterygium consists in an enlargement and multiplication of the conjunctival vessels, with hypertrophy of the adjacent conjunctival and subconjunctival tissues. Its usual form is that of an isosceles triangle, with its apex at, or in the direction of the centre of the cornea, and its base at the inner canthus. More rarely it is seen at the outer canthus, or at other points of the circumference of the eye. It is sometimes a sequela of conjunctival inflammations, of herpes, and of ulcers, but in many examples no special provocation can be assigned. Its progress is usually very slow, but uninterrupted, until it reaches the centre of the cornea. It may occur in both eyes simultaneously, but in general the progress of the two pterygia is unequal.

When a pterygium has made but little progress, its further growth is sometimes arrested by the application of astringent collyria. In a few cases a permanent cure may be effected by these agents, but pterygia are seldom radically cured except by thorough excision.

Fig. 286.



Operation for Pterygium.

Operation.—The operation of excision consists in seizing the growth near its apex with a pair of delicate mouse-tooth forceps, and, with the scissors, dissecting it back nearly to its base. About one-half of the apex should then be excised, and the remainder of the flap allowed to fall back toward the canthus. Much of the success of the operation will depend upon the car which is employed to include all of the vascular and hypertrophi tissues in the dissection. When the wound remaining after excision large, it is advisable to detach the ocular conjunctiva from th sclerotica to a sufficient extent to enable the surgeon to draw th margins of the incision easily together, and then unite them wit delicate sutures. In some cases it may be necessary, in order accomplish this, to incise the conjunctiva near the palpebral fold, at right angle with the original incision. A few operators prefer to clo the wound made by the operation, with sutures, in all cases.

Strangulating a pterygium by ligatures, recommended by Szokalsk ers no advantages over excision. Destruction by caustics is painful, lious, and apt to be followed by ugly cicatrices. The pterygium is o more liable to return after its destruction by caustics than after cision.

Diseases of the Cornea.

Keratitis, R. C.; Corneitis.—Inflammation of the cornea may be ute or chronic. Acute keratitis, of the more intense forms, sometimes sults in extensive ulceration, or in sloughing of the cornea.

In most cases this affection is presented in a chronic form, and is en characterized by the formation of one or more minute ulcers, with bulous zones; and usually a few straggling conjunctival vessels are en scattered upon the surface, leading especially in the direction the ulcer. The sclerotic vessels are also, in most cases, sufficiently volved to render them visible just beyond the margins of the cornea. s the inflammation progresses, the deposits of lymph between the yers of the cornea increase, and vision becomes greatly obscured. In ceptional cases the cornea is completely perforated by the ulceration; pus is formed between its laminæ, and extravasated into the nterior chamber, or perhaps upon the outer surface. Very chronic ratitis usually results in increased convexity or actual conicity of the rnea.

Treatment.—In the vast majority of these cases the patients require nics and nutrients. As local applications, weak solutions of sulphate zinc are generally useful—one to three grains to the ounce. None the salts of lead should be employed here, or in any case attended th ulceration over the cornea, since they are apt to leave a permanent in.

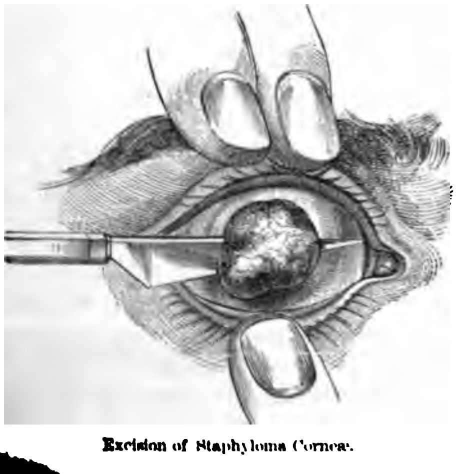
Opacity of the Cornea. Syn., Cornea Opaca, R. C.—*Nebula*, is e term applied to a diffuse and moderate opacity of the eye, consent, generally, upon inflammation of the conjunctiva or cornea, and e to fibrinous deposits. It disappears in most cases slowly, after the mplete subsidence of the inflammation. When the opacity from the me cause is more considerable it is termed *albugo*. This latter is re apt to be permanent; but time and the judicious use of stimulat- g collyria will sometimes effect a cure. *Leucoma*, is a corneal and njunctival cicatrix, the result of a loss of substance, and is not ameble to treatment, although the limits of the opacity may become narved by the lapse of time.

Arcus Senilis, R. C.—As age advances, the outer circumference of cornea usually becomes opaque, in consequence of a fatty degention of the corneal tissue; but this condition has no special significe as indicating a similar degeneration of the heart, as some have gined. It seldom progresses so as to interfere with vision, and nands no treatment. Occasionally, the arcus senilis is seen in young persons, just as the hair is now and then observed to become white in early life.

Conical Cornea. Syn., Cornea Acuminata, R. C.; Keratoconus. —As a sequela of chronic keratitis, but quite as often wholly independent of any form of inflammatory affection, the cornea occasionally assumes a conical form. In most of these examples the patients are young and anæmic, or below the standard of complete health. The change in form is usually very gradual, and is coincident, sometimes, with a loss of its natural transparency, and with a diminution in thickness. The opacity, when present, commencing at the margins, gradually spreads like a thin veil over the entire surface; the cornea becomes especially thin at its centre, but it seldom gives way completely; the iris is tremulous and unusually dilated. This malady generally appears in both eyes, either simultaneously or consecutively.

Treatment.—In addition to constitutional treatment, which must be tonic and nutritious, the patient should not be permitted to overtask his eyes. Concave glasses afford relief to vision when the conicity is moderate, and in the later stages vision may be improved by the use of disks of Buffalo horn, perforated by narrow slits, by which, virtually, the size of the pupil is diminished. Bowman suggested fixing the pupil and diminishing its size, by perforating the cornea and securing anterior synechia; but this operation has lately fallen into disfavor, in consequence of the frequency with which irido-cyclitis has resulted; and ophthalmologists are just now experimenting with a method proposed by Graefe. The apex of the cornea is carefully sliced off, and the resulting ulcer is touched occasionally with nitrate of silver in substance. After a time the ulcer is permitted to heal, when the cornea flattens, leaving a small central opacity. Subsequently more complete vision is restored by iridectomy performed at the margin of the cornea.

Fig. 287.



Excision of Staphyloma Corneæ.

If the protrusion seems to threaten a rupture, the tension may be relieved temporarily by puncturing with a cataract needle at some point of the margin of the cornea.

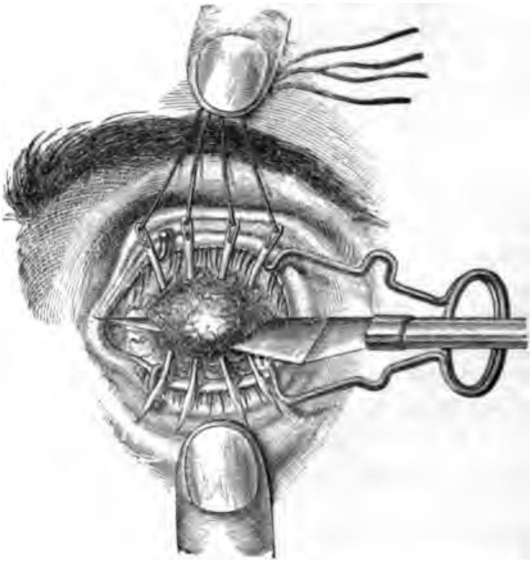
Staphyloma Corneæ. Syn., Uva Corneæ, R. C.—In consequence of complete perforation of the cornea from ulceration, and the subsequent escape of the aqueous humor, the iris may fall forwards, and, [illegible]ching itself to the margins of the opening, repair the corneal [illegible]nd prevent the further escape of the intraocular fluids. New will now occur upon the outer surface of the exposed iris, con- ; a tolerably dense cicatricial tissue, but not sufficiently firm nt protrusion in consequence of the pressure of the fluids, aided action of the ocular muscles. There will result a somewhat r protrusion, of a bluish color, called staphyloma, from its sup- semblance to a bunch of grapes.

ment.—When a staphyloma attains such size as to interfere e movement of the lids it must be excised, sometimes with a of the sound cornea. The wound in the cornea subsequently nd, if the lens and vitreous humor have not been disturbed, a d stump is left for the support of an artificial eye.

ma Scleroticæ. Syn., Uva Scleroticæ, R. C. Sclero-choroidal Staphyloma.

the anterior portion of the sclerotic coat is the seat of this , it is recognized by one or more protrusions a little beyond r margins of the cornea, of a bluish-black color, resembling cases melanotic tumors, but easily distinguished by their reced- ler pressure. The color is due to the pigment of the choroid y body, which becomes visible through the attenuated walls of ca sclerotica.

Fig. 288.



Critchett's Operation for Staphyloma Corneæ.

such protrusions prevent the closure of the lids it may become ry to remove the cornea, with a ortion of the tu- lerotica. Mr. tt, in performing eration, introdu- or five sutures, terior to the cili- ion, by transfix- eye from above rds before prac- xcision, in order the prompt clo- the wound he id, in some mea- e danger of an of the lens and humor.

e been able to nporary relief in es by occasional . Excision of the eye may be required; but this alternative be avoided if possible, on account of the inadequate support n empty socket gives to an artificial eye.

Recent investigations with the aid of the ophthalmoscope have shown that sclerotic staphyloma is not unfrequent in the region of the optic nerve, and that it is a frequent accompaniment of myopia.

Occasionally, also, we meet with examples of a pretty general distention and attenuation of the sclerotic coat, but which condition is not incompatible with a tolerably fair amount of vision. I have seen this "total staphyloma" continuing many years in both eyes without much loss of sight.

Total staphyloma is incurable, if we understand by a cure, a restoration of the eye to its normal size and form; and there is nothing but improvement of the general health which is able to delay or to arrest its further progress.

Diseases of the Iris.

Inflammation of the Iris. Syn., Iritis, R. O.—Inflammation of the iris may be recognized by the sluggishness and irregular contraction of the pupil; by the dull, lack-lustre appearance of the iris, and by certain changes in color; occasionally a single vessel may be seen, or minute points of lymph upon its surface, and especially on its free margin; by the pericorneal zone of vascularity, the sclerotic and ciliary arteries being congested and presenting, to the naked eye, an appearance as if the sclerotic were pencilled with a delicate lake or rose-colored paint; but under the glass this color is seen to be due to the small, straight, converging arteries of the tunica sclerotica, over which the darker, larger, and more tortuous vessels of the conjunctiva may be distinctly seen. There is also, usually, deep, tensive pain, moderate photophobia, and lachrymation, with impaired sight.

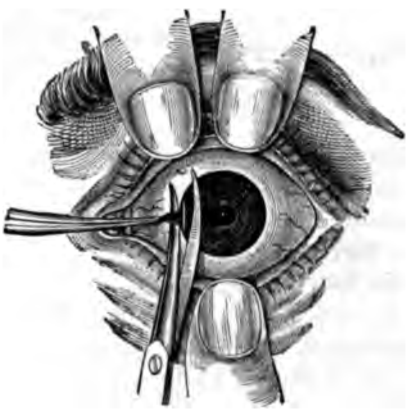
Various forms of iritis have been mentioned by writers, such as serous and parenchymatous, a classification based upon the structure involved; also idiopathic, traumatic, strumous, syphilitic and rheumatic.

A very large proportion of cases of iritis terminate spontaneously, or, under suitable hygienic management, in from two to four weeks, leaving no results except a remarkable tendency to relapse. In the exceptional cases, when the disease is unusually active, and considerable effusions of lymph have taken place, the prognosis is not so favorable; the iris becoming permanently anchylosed by adhesion of its muscular fibres, or by adhesion to the capsule of the lens, constituting **synechia posterior**, or by adhesion of the opposing free margins, constituting **atresia pupillaris.**

Treatment.—Mercury is no longer considered essential, or, indeed, useful in this affection, except in purely syphilitic cases; and even in these examples it is by no means certain that mercury is indispensable. It is of first importance, however, to give attention to the general health, and to correct the constitutional dyscrasy upon which the exist-the disease usually depends. Second, the pupil must be kept ted, to prevent, as far as possible, those disasters which have ntioned above as occasionally resulting from the effusions of In order to accomplish this latter purpose, we ordinarily em- pine, in the proportions of one-eighth of a grain to the drachm , of which a drop may be placed between the lids six to twelve ly. If necessary, the strength of the solution may be increased lf of a grain, or to one grain to the drachm. To Dr. Williams, n, the profession is especially indebted for this simple and l method of treating iritis.[1] In exceptional cases, leeches, ca- and opiates may be demanded; but the iodide of potassium, and other tonics are more often indicated.

tomy. Syn., Iridectomia, R. C.—The operation of iridec- practised for a variety of lesions and ocular disturbances: as nple, in cases of atresia s, or occlusion of the pu- ed also synezisis pupillæ, yosis—a partial closure of ; in glaucoma and staphy- opacities of the cornea; al opacities of the lens capsule; in dislocations ens, etc., etc.; but most dectomy is practised for of complete occlusion of l.

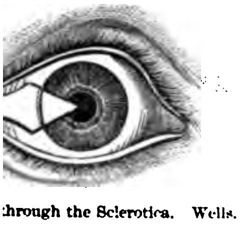
Fig. 289.



Iridectomy through the Cornea.

ethod of operating recom- by Beer continues to be as the most simple, safe, furnishing the best aver- lts. Beer's operation is as follows:—An opening is made the cornea—in most cases near its outer margin, or through a sclerotica in front of the iris—of two or three lines in length, and, if the iris does not escape sponta- neously with the aqueous humor, a del- icate pair of forceps or an iris hook is introduced, the iris seized, brought out, and excised by scissors..

Fig. 290.



hrough the Sclerotica. Wells.

In some cases of complete occlusion of the pupil, and especially when there is no lens in situ, a very satisfactory re- sult may be obtained by simply dividing the converging muscular fibres of the cataract needle or narrow iris-knife. If the wound in the iris does not open sufficiently, it may be enlarged by seizing its margin with a Tyrrell's hook, drawing it out of the corneal wound and excising a portion.

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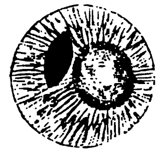
[1] *Diseases of the Eye*, by Henry W. Williams, Boston, Mass., 1867.

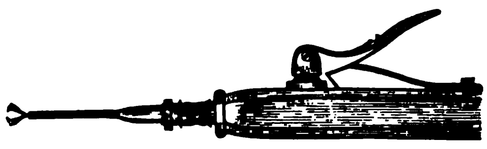
Fig. 291.



Iridectomy by Incision.

Iridodesis. Syn., Iridesis.—Displacement or elongation of the pupil, in one direction or another, is occasionally substituted for iridectomy in cases of conical cornea, partial opacity of the cornea or lens, displacement of the lens, and congenital cataract. In order that it may be applicable, the pupillary margin must not be adherent, or its adhesions must first be broken up. The operation of iridesis is made by introducing a narrow knife through the cornea, seizing the iris with a hook, or the canula forceps, withdrawing it through the external wound, and strangulating it with a ligature.

Fig. 292.



Canula Forceps. Wells.

Iridenkleisis differs from iridesis only in that the incision is made through the sclerotica instead of the cornea, and in that no ligature is employed for the strangulation of the iris; the surgeon trusting to the smallness of the orifice, and the adjustment of the protruding iris, to insure its retention and strangulation.

Corelysis.—Detachment of the pupillary margin of the iris from the anterior capsule of the lens is also, in some cases, a proper substitute for iridectomy. The pupil being already well under the influence of atropine, or of some other mydriatic, an incision is made in the cornea with a narrow knife or cataract needle, through which a small spatula hook is at once introduced, carried beneath the iris, and the adhesions gently broken. Or, with greater assurance of success, and more safely, perhaps, we may substitute the operation of Passavant, which consists in seizing and detaching the iris with a fine pair of forceps.

Iridodialysis.—The formation of an artificial pupil, by detachment of the iris at its ciliary margin, is especially adapted to examples of general opacity of the cornea, but in which a small portion near the ciliary margin remains transparent. The incision is made through the opaque cornea, but near that portion which is transparent; with a hook or pair of forceps the iris is then detached at its ciliary margin, drawn out and cut off.

Diseases of the Choroid.

Inflammation of the Choroid. Syn., Choroiditis, R. C.—Inflammation of the choroid coat, resulting in serous, pigmentary, and plastic exudations, especially between this membrane and the retina, can be detected only by the ophthalmoscope. It is believed that congestions are inflammations of this membrane cause many serious intra-ocular lesions. The whole subject is, however, too little understood at the present moment to authorize its further consideration in a general treatise.

Apoplexia Choroidea, R. C.—Effusion of blood from the choroidal vessels occurs in consequence of sudden lesion, the extravasation appearing between the choroid and retina, and separating these two membranes to a greater or less extent. Its existence is determined by the ophthalmoscope. When the quantity of blood effused is small it may be absorbed and vision completely restored.

The treatment demands rest, and such general measures as the condition of the system may indicate.

Diseases of the Retina.

Inflammation of the Retina. Syn., Inflammatio Retinæ, R. C. Retinitis.—Acute, uncomplicated, idiopathic retinitis is exceedingly rare; since the introduction of the ophthalmoscope, however, it is pretty often recognized in a passive form, accompanied with exudations. Intolerance of light is often a prominent subjective symptom of this affection, but its absence or presence is by no means diagnostic.

Rest and occlusion of light are the most important therapeutic measures; to which may properly be added, in some cases, low diet, cathartics, cupping, and blood-letting.

Apoplexia Retinæ.—Apoplexy of the retina is of rare occurrence. The prognosis will vary according to the extent of the extravasations, and according as it is dependent upon permanent lesions of the heart or of other organs. The most unfavorable cases are those in which the extravasations are scattered in small masses over the entire surface of the retina, as in certain examples of cerebral affections. This condition has been termed *retinitis apoplexia.*

In Bright's disease of the kidneys, similar disseminated extravasations are often seen in connection with a radiated, whitish appearance of the retina, indicating the progress of certain morbid changes in its structure. These appearances have also been observed in the retina of persons laboring under secondary and tertiary syphilis.

Amaurosis, R. C.; Syn., Gutta Serena.—The term amaurosis has been usually employed to indicate loss of vision, due to certain morbid conditions of the retina, optic nerve, or brain. Stellwag restricts the use of the term to that total loss of vision in which light cannot be distinguished from darkness; and Wells suggests that it would be better to confine it to primary atrophy and degeneration of the optic nerve. All other forms and degrees of impaired vision, depending upon disturbance of the optic nervous apparatus, will then be designated *amblyopia.* The advance of ophthalmic surgery, no doubt, demands precision in the use of terms, but inasmuch as both of these terms express a symptom and not a pathological condition, nothing is gained by the substitution. It is just as exact to speak of partial and complete amaurosis as to indicate these degrees by the terms amblyopia and amaurosis. Moreover, if "amaurosis" is hereafter to imply a specific pathological condition, it is certain this condition must exist in varying degrees, and it is inconsistent with the usual plan of nomenclature to change the name where the character of the lesions remains the same.

Amaurosis may be caused by the retrogressive changes in the nervous apparatus incident to age, by tumors and other lesions of the brain, by congestion of the retinal vessels, embolism of the central artery of the retina, extravasations of blood upon the optic nerve, inflammatory effusions; by anæmia, by pregnancy, Bright's disease, tobacco, opium, and various forms of blood-poisoning. There are many other causes which are known to produce amaurosis, either directly, or as the results of sympathy with remote organs.

The amaurosis of old age, which is the most characteristic form, usually commences with slight obscurity of vision, and the appearance of floating motes—*muscæ volitantes;* and when it is nearly or quite complete the retina is insensible to light; the lids are usually wide open or staring, and the eyes have a vacant, wandering expression.

Treatment.—The causes of amaurosis are so numerous and opposite in their characters, that it is impossible to indicate the appropriate treatment further than to say, that, the cause being ascertained, it should, if possible, be removed. If the amaurosis depends upon congestions which are still present, measures must be adopted to unload the vessels; if upon anæmia, nutrients and tonics are required.

It may be observed, however, that, whatever may have been the cause, its removal does not always, nor even generally, restore the visual function; certain organic changes having resulted from simple disuse, or from the immediate operation of the primary cause, which disable the apparatus permanently, in a large majority of cases. To overcome these later and secondary conditions, electricity, strychnine, and other remedies of this class, can alone offer any hope of success.

Glaucoma, R. C.

According to Donders, glaucoma may be properly divided into two varieties, namely, *glaucoma simplex*, and *glaucoma cum ophthalmia.*

Glaucoma Simplex is more common in women than in men, and occurs generally after the fortieth year of life. Among the earliest symptoms are presbyopia, dimness of vision, an iridescent halo seen about the light of a candle, and a sluggish pupil. Increased tension of the eyeball is an early symptom, but it is apt to escape notice until a later period, when, to slight pressure with the finger, the ball feels remarkably tense and hard. In confirmed glaucoma simplex there is also limitation of the field of vision and deficiency in direct vision. The characteristic intra-ocular signs are excavation of the optic nerve d abnormal pulsation of the retinal vessels, or a pulsation exaggerated slight pressure upon the ball.

Glaucoma cum Ophthalmia, or the inflammatory form, may be ute or chronic. Each is characterized by more or less vascularity of e ciliary region, or the presence of the pericorneal pink zone; by a rbid greenish or smoky appearance of the pupil, not unlike that hich is presented in senile cataract, and for which, indeed, it may be sily mistaken. There are present, also, the other phenomena belong g to simple glaucoma, already enumerated. Tension of the ball, owever, and abnormal pulsation of the retinal arteries, constitute here, s in all other cases, the chief pathognomonic symptoms: conditions hich seem to be due to increased intra-ocular secretion, and to coinci ent hardening of the tunica sclerotica.

Glaucoma in either form, unless arrested by early and appropriate reatment, almost inevitably results in complete loss of sight. The lens nd its capsule frequently become opaque; the vitreous humor diffluent; he iris atrophied; the optic nerve excavated, shrunken, and paralyzed; he retinal veins varicose, and, in short, a general disorganization of the nterior structures of the eye sooner or later results.

Treatment.—The treatment of this malady consists in the adoption f appropriate measures to improve the general health, which is in most ses impaired, in absolute rest for the eyes, and in the operation of idectomy. Indeed, I may say that, in the opinion of some excellent ecialists and surgeons, the treatment is reduced to the operation of idectomy alone. This operation, first practised for the relief of glau ma by Von Graefe, in 1856, has now been made a great number of nes and with a remarkable degree of success.

Nevertheless, the operation seems to be wholly empirical, since ither Von Graefe, nor any of his followers, have as yet been able to rnish any satisfactory reasons for its success. Dr. Noyes, of this city, s written a very instructive paper in defence of its claims, and re rted a number of successful examples from his own experience.[1]

The mode of operation, by incision through the sclerotica, has been eady described in the section on iridectomy.

Cataract. Syn., Suffusio, R. C.

A cataract is an opacity of the crystalline lens, of its capsule, or of h.

The etiology of cataract remains in a great measure undetermined. s probable, however, that the immediate causes of lenticular opacity certain changes in the quantity and quality of the fluid elements of lens, as a result of endosmosis and exosmosis. The lens has no blood-vessels, but, being suspended in fluids, it is nourished by imbibition In youth, when the proportion of fluids is greatest, endosmosis may exceed exosmosis, and a soft cataract will be the result. In advanced life the opposite condition obtains, and exosmosis may exceed endosmosis, resulting in the formation of a hard cataract. The opacity is then, in either case, due chiefly to the lack of homogeneity in the structure of the lens, for the microscope shows no change of structure until long after the cataract has been completely developed. The changes which then occur are the results of degeneration and disintegration, or of solution, the solids which remain after the maturation of hard cataract being albuminous, fatty, cretaceous or osseous; while the fluid and cystic cataracts are the result of solution of the connective and other intra-capsular tissues. Dr. Knapp supposes, moreover, that the frequency of soft cataract in connection with diabetes mellitus, is to be attributed to the loss of sugar and the consequent resorption of water by the lens.

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[1] Glaucoma, by Henry D. Noyes, M.D., Prof. of Ophthalmology in Bellevue Hospital Col.; Surgeon to New York Eye and Ear Infirmary. *Trans. N. Y. State Med. Soc.*,

Lenticular Cataract.—Opacity of the lens occurs most frequently after the middle period of life. It is sometimes *congenital*, and it may occur at any period, especially from *traumatic injury*. When one lens has become cataractous, the opposite lens, usually, very soon becomes opaque also. In most cases of lenticular cataract, the capsule is not involved. The color, consistence, and size of the cataract vary in different cases. They are, accordingly, divided into hard, soft, and fluid.

Hard, or Nuclear Cataract, is seen most often in advanced life. The yellow opacity commences in the nucleus of the lens, and extends gradually towards the periphery; at the same time, however, the cortical portions are assuming a whitish opacity. Its color is generally a dark ash, inclining to yellow or amber; sometimes it has a mahogany color. The slight amber tinge seen in the centre of the lens of most old persons, unaccompanied with impairment of vision, must not, however, be mistaken for cataract.

Soft Cataract, called also **cortical,** commences in the cortical layers of the lens, and the opacity extends, generally, by converging lines towards the centre, gradually diffusing itself at the same time throughout the whole structure. Its color is usually grayish white, sometimes with a tint of yellow in the centre. It may present a pearly, or an irregularly opaque appearance.

Fluid Cataract, which has been placed by recent writers in the same class with soft cataract by the application of the common term "cortical," commences also in most cases in the cortical layers, the interior undergoing a subsequent degeneration, liquefaction, and consequent opacity. This variety obtains especially in congenital and infantile cataract. In many cases of congenital cataract, however, the opacity commences between the nucleus and the cortical layers, and this form has been named *lamellar*, or *zonular;* for a time, longer or shorter, the outer portions remain transparent, affording, occasionally, an opportuo the surgeon of improving vision by substituting iridectomy, or ɔrmation of a lateral pupil, for the removal of the cataract. Old acts are also, sometimes, fluid; but they seldom present, before val, the milky color belonging to congenital fluid cataracts, nor the liquefaction extend usually to the central portions.

hen the nucleus floats in a softened senile cataract, or rests at the m of the capsule, it constitutes that variety formerly known as the gagnian cataract. When a cataract of this variety is removed and ed, the fluid portion is seen to possess a milky color, the original r color having depended solely upon the presence of the nucleus. nally, in both old senile cataracts and in congenital cataracts, the elements may be so absorbed that the cataract appears shrivelled lat; while other elements undergo a fatty or chalky degeneration, dhere to the inner surface of the capsule, where they may remain the lens is removed. This form is described in most treatises as *iliculose* or *chalky capsulo-lenticular cataract.*

agnosis of Cataract.—The existence of a mature, or complete cat-, is in general easily recognized by the unaided eye; but immature acts are sometimes difficult to diagnosticate. The usual signs are ire vision, the obscurity being increased in certain cases of central act, when the pupil is made to contract under the influence of a g light; so that the patient sees best in a cloudy day, or in the ght, and he walks habitually with his brows drooped, or with his shaded by the hand. Under these circumstances dilatation of the l, by the employment of mydriatics, improves vision; an expedient ich empirics often resort, to persuade these patients that the cata- is being removed. The pupil is sluggish, or does not contract so as the pupil of the sound eye.

ie condition of the lens can be more fully determined by dilating ɔupil thoroughly before examination, and by the aid of a convex If further information is needed to determine the precise char- and situation of the opacity it is obtained by the ophthalmoscope, by oblique illumination. Direct illumination throws the shadows ie opaque spots upon the fundus of the eye; but by oblique illu- tion the opacities are referred to their proper position in the lens. ne aid of lateral light, also, we may be able, in cortical cataracts, to ve convex radii upon the anterior, and concave radii upon the rior surfaces of the lens; which superficial and deep opacities were erly supposed to indicate anterior and posterior capsular cataract, which Sanson's famous catoptric test was supposed to verify. The nalmoscope and dissections have shown that these opacities almost iably belong to the superficial layers of the cornea.

aumatic Cataract may result from a wound which has actually trated the capsule, admitting the aqueous humor to the lens; in h case the lens soon becomes swollen and opaque by absorption of uid. In many examples of puncture, or laceration of the capsule, the opacity remains for several months or years, and then gradually disappears by solution and absorption of the lens; in other words, a spontaneous removal of the cataract takes place.

There is a second variety of traumatic cataract, resulting generally from concussion of the eyeball; in which the suspensory ligaments of the lens are supposed to be broken, and its nutrition consequently arrested. In these cases the lens undergoes a gradual atrophy, and opacity may be delayed many months or even years.

The color of traumatic cataract is usually white, with a tint of blue or of gray. After spontaneous absorption of the lens the capsule is sometimes found opaque, presenting a gauze-like appearance, or it may be more densely and uniformly opaque, or it may undergo cretaceous degeneration.

Capsular Cataract.—According to the later researches, the capsule itself never becomes opaque, but the condition termed capsular cataract is the result of deposits or neoplasms upon either the inner or outer surface of the capsule. Müller observes that the new formation sometimes very much resembles the structure of the capsule, and at other times it is fibrous. We have already alluded to certain chalky degenerations of the cortical layers of the cataractous lens, which sometimes remain adherent to the inner surface of the capsule after extraction, in that variety of cataract called "siliculose."

In the latter stages of irido-choroiditis the so-called capsular cataract is apt to occur as a result of proliferation of the intra-capsular cells; the actual seat of the opacity being, in this case also, between the capsule and the lens.

Anterior Central Capsular Cataract is the result of central ulcerations of the cornea, and contact of the capsule with the point of ulceration; or, as Mr. Hutchinson supposes, when it ensues upon purulent ophthalmia, it is due to disturbed nutrition. When the central opaque spot is much elevated it is termed *pyramidal cataract.*

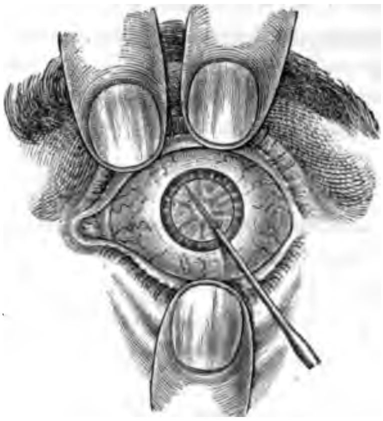
Operations for Cataract.—No remedy except an operation has yet been discovered for cataract. The following rules, not universally accepted by ophthalmologists, have hitherto been observed by myself in all operations for cataract. First, no preparation is necessary or useful when the health of the patient is perfect; second, operations may be made without reference to the season of the year; third, the earlier a congenital cataract is operated upon the better; fourth, in all other forms the operation should not be made until the cataract is mature; fifth, one eye should not be operated upon while the opposite eye retains useful vision.

To the fourth proposition there may be presented this apparent exception. The opacity in some cases never becomes complete, since it may never extend beyond those intermediate laminæ in which it was originally found; and, under these circumstances, if both eyes are affected, and the use of mydriatics does not supply useful vision, the ı is justifiable, even when in a certain sense the cataract is not

tion by Division. Syn., Discission; Absorption; Solutio R. O.—This method is especially applicable to the various forms ct occurring in childhood, except to the siliculose cataracts.

operation may be made the cornea, *keratonyxis;* or the sclerotica, *sclerotico-hyalonyxis.*

Fig. 293.

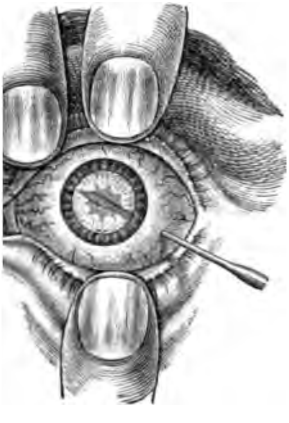


Keratonyxis.

Keratonyxis is best per- vith a straight, delicate stop- The pupil having been di- th belladonna or atropine, ument is made to penetrate ea perpendicularly at the f the lower and outer quad- e direction of its point is nged, and it is pushed for- › the inner and upper bor- he pupil; the capsule is ɔy a light crucial incision, ıeedle is withdrawn.

l; **Scleroticonyxis** is especially suited to cases in which opaque upon the capsule may render it necessary to remove it from the sion. A spear-shaped needle, after dilatation of the pupil, is in- perpendicularly through the sclerotica, one and a half lines beyond the cornea, and one or two lines below the equator of the eye; the point is then carried inwards and a little forwards, between the capsule and the iris, as far as the inner and upper pupillary margin; with the cutting edge of the needle the capsule is divided, and the needle is withdrawn. If necessary, the capsule with its broken lens may be reclined towards the vitreous humor, with the flat surface of the needle, before its withdrawal.

Fig. 294.



Scleroticonyxis.

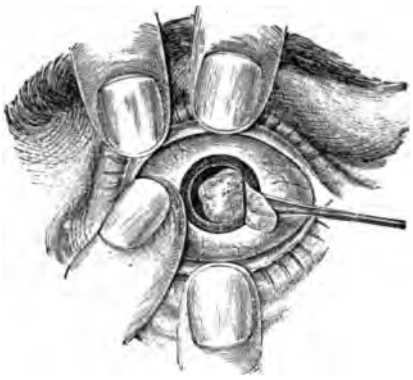
After either of the preceding operations the eyes should be closed and the pupil kept dilated during several days. Slight vertigo and ometimes follow immediately the operation, but these soon ›ntaneously.

ption does not always take place speedily, unless the cataract is quite soft, or fluid; but after a few days, and sometimes weeks, a gradually increasing dark spot in the lens will indicate the progress of absorption; which process may not be completed, however, under several weeks or months. If, after the lapse of a suitable time—and I prefer to make this period not less than two or three months—the absorption is not satisfactory, the operation may be repeated. In one case I have operated six times successively; and in the end a complete cure was effected. Such is not, however, the usual result of repeated operations upon the same eye, since in a large majority of cases the susceptibility to inflammation steadily increases after each operation, and in the end it is likely to prove destructive.

Operation by Extraction. Syn., Detractio Lentis, R. C.

Linear Extraction.—This operation, not hitherto very much practised, is, according to Stellwag, especially indicated, 1st, in fluid, pulpy and pasty, total cataracts; 2d, when fragments of soft cataracts are pressing upon and disturbing the iris after a wound of the capsule; 3d, in shrunken cataracts without nuclei, especially in siliculose cataracts.

Fig. 295.



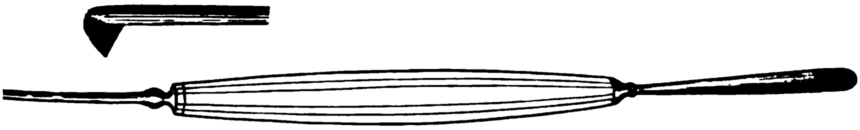
Linear Extraction by aid of Daviel's Spoon.

The pupil having been dilated, a broad, lance-shaped knife is introduced through the outer side of the cornea, one line from the sclerotica; the point is pressed forwards toward the inner canthus, in the plane of the iris, until a vertical incision is made two lines in length, and then slowly withdrawn, while the aqueous humor escapes. A curved needle is now introduced and the capsule cut; when, if the lens does not present itself spontaneously, slight pressure upon the opposite side of the ball will generally succeed in effecting its extrusion.

In some cases it will be necessary to facilitate the escape of a pulpy cataract, by making the corneal wound more patulous by pressure upon its posterior margin with a Daviel's spoon, as represented in the wood-cut. Finally, if these measures fail, the lids must be closed and the aqueous humor allowed to accumulate, and then slight rotary pressure made upon the upper lid with the ball of the finger. If the capsule is opaque, or shrivelled and tough, it must be removed by the sharp hook, or iris forceps.

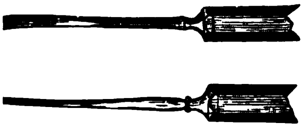
Flap Extraction.—Flap extraction is especially suited for hard cataracts, including all of those in which the nucleus remains hard, although the cortical portions may have softened. This description it ll be observed, applies to nearly all senile cataracts, and to a few ceptional examples of cataract in middle and early life. The instruents required are a Beer's cataract-knife, a pricker, or Graefe's cysto-

Fig. 296.



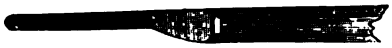
Graefe's Cystotome.

Fig. 297.



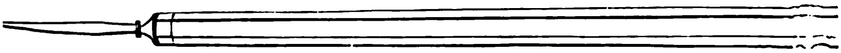
Pricker and Curette.

Fig. 298.



Probe-pointed Knife.

Fig. 299.



Hook.

ome for dividing the capsule, an iris hook, mouse-tooth forceps, a aviel's spoon, scissors, and a probe-pointed knife. There are two rincipal modes of flap extraction now practised. In one, the flap is ade from the lower section of the cornea; in the other, from the pper section.

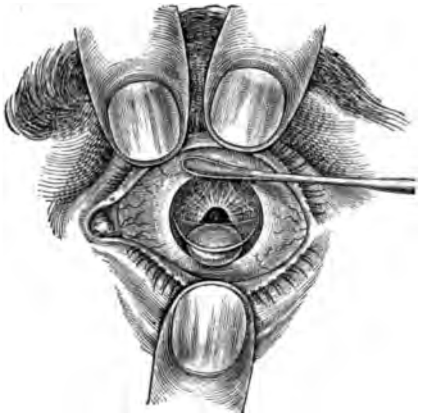
The operation by the *lower section* is made as follows:—In case he operation is to be made upon the left eye; the patient being eated or reclining, as the surgeon may elect, an assistant elevates ith his fingers the upper lid without pressing upon the ball, while he surgeon depresses the lower lid with the fingers of his left hand; nd resting his right hand, which holds the knife, upon the malar one, the point is entered perpendicularly to the cornea, a little below e equator, and close to the sclerotic margin; the moment the point as penetrated, the direction of the blade is changed to the plane of e iris, and it is carried steadily inwards to the opposite point of the rnea, which is transfixed, and the point pushed inwards toward the se, until the section of the flap is nearly completed; the remaining rtion of the flap being severed by a slight sawing motion, without essure.

As the patient is disposed always to turn the eye inwards the moment is touched with the knife, it is well to direct him to incline the axis little outwards. If, through inability on the part of the patient to ntrol the ball, or from lack of skill on the part of the surgeon, the nife cannot be made to enter and fix the eye before the inward rotation takes place, it will be necessary that an assistant should seize the conjunctiva deep at the inner canthus with mouse-tooth forceps, and hold it until the knife has made the counter-opening.

If the aqueous humor escapes too rapidly, and the iris falls under the edge of the knife, slight friction upon the cornea with the ball of the finger will sometimes cause it to contract, and to become disengaged. If this does not succeed, and the portion prolapsed is small, the operation may be at once completed, although the iris will be necessarily wounded; but if a large fold is involved, it will be best to withdraw the knife, close the lids a few minutes, and then proceed to complete the operation with a probe-pointed bistoury.

The second step of the operation consists in opening the capsule, which must be anticipated by a few seconds of rest, with the lids gently closed. The lids are then opened, and the needle introduced by laying its side against the lower lip of the flap, and carefully raising its point to the upper margin of the pupil, through which the capsule is reached and torn freely. At this moment the contraction of the ocular muscles is often sufficient to dislodge the lens; and its extrusion is completed almost simultaneously with the withdrawal of the needle. If its expulsion is delayed, slight pressure upon the ball with the finger or the spoon may prove sufficient; or, if arrested at the corneal opening, it may be extricated by the aid of the scoop or the hook. If, unfortunately, any portion of the vitreous humor escapes, it must be carefully excised with the scissors. Attempts to return it are generally unsuccessful, and expose the patient to the danger of more complete extrusion, and consequent total loss of vision.

Fig. 300.



Flap Extraction.

When the operation is completed, and the surgeon has assured himself that no fragments remain, the lids of both eyes are allowed to close, and their occlusion is maintained by narrow strips of adhesive plaster, or by light compresses: these being removed daily for the purpose of ascertaining the condition of the eye, and then reapplied. The flap is generally found united on the fourth or fifth day, but the occlusion must be continued three or four days longer.

The patient ought not to be allowed for a moment to bend his head forwards after the operation, but he must be laid upon his back, with his head elevated, and all necessary precautions taken that during his es not touch his eyes. His diet should be moderate, and his uld not be permitted to become constipated. The room darkened, and no strong light should be admitted to his eyes three weeks.

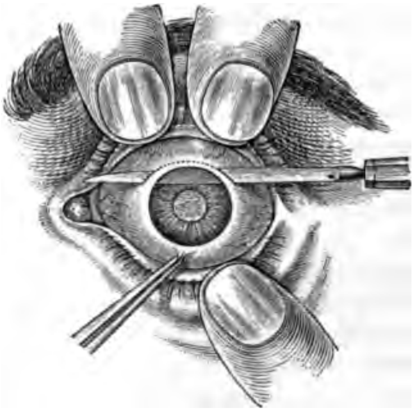
urgeon is ambidexter, he will adopt the same rules of procee case of the right eye, with only such modifications as the hands will require. If he is not, he will stand behind his ing the operation, elevating the upper lid with the fingers of id, while an assistant depresses the lower.

ration by the *upper section*, to which Jaeger gives the prefercases, possesses the following advantages;—the iris is not so ll against the knife, nor to escape through the corneal wound; lid, being longer, is not in danger of fretting or opening the ident which happens, sometimes, in the lower flap operation, roximity of the margin of the lower lid to the corneal incision; x is less observed, and, if the iris is injured, it does not so much ith vision. On the other hand, owing to the tendency of the upwards, as well as inwards, during the operation, and to the gth of the upper lid, the operation is more difficult, and ex part of the surgeon much more skill and adroitness.

thod differs from the one previously described only in that the fifths—more or less, as the size of the lens may require—of is chosen for the flap. To prevent the eye from rolling up, ctiva may be seized below the centre of the ball, with the d held by the assistant.

s, of Boston, has been event the insinuation of lid beneath the flap, in flap section, by closing in the cornea with a desuture.[1]

Fig. 301.



Graefe's Modified Peripheric Linear Extraction.

d Linear Extraction—c Linear.—This method, y Von Graefe, and ap-Wells, Bowman, Noyes, d very many other ophists, is in reality a modiboth the flap and linear The operation is divifour processes, namely: ridectomy, laceration of e, and extraction of the lens. The instruments required are eculum, fixation or mouse-tooth forceps, Graefe's narrow-

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of the Eye, by Henry W. Williams, Ophthalmic Surgeon to the City Hospital, 7, p. 193.

bladed knife, an iris forceps, scissors, a sickle-shaped needle, a sharp and a blunt hook, and a spoon.

The patient being under the influence of an anæsthetic, the lids are opened by Noyes' speculum—an instrument to which most operators now give the preference—while the ball is secured in position by the fixation forceps, as represented in the accompanying wood-cut; the operator then introduces his knife in the sclerotica, one-third or half a line back of the cornea, and about two lines above the horizontal diameter of the eye; the point is at first directed a little downwards and backwards, but when the sclerotica is fairly transfixed, it must be elevated and carried to a point in the sclerotica directly opposite its point of entrance; the counter-opening being made, the edge is inclined backwards, and following the margin of the sclerotica until the section is nearly completed, or until the edge of the knife rests against the inner surface of the upper segment of the sclerotica, the edge of the knife is then turned pretty abruptly forwards or in the direction of a short curve, so as to divide the sclerotica at a right angle with its surface, and to make of the conjunctiva a small flap.

The second step of the operation consists in withdrawing a fold of the iris near the temporal margin and removing it with the scissors. In lacerating the capsule, which is the third step, care must be taken to carry the needle as close to the periphery of the lens as possible, especially in the direction of the sclerotic opening, and to divide it freely. Finally, if the sclerotic incision and the laceration of the capsule are properly made, the lens often presents itself promptly at the sclerotic opening, and its complete extrication may be effected by drawing upon the fixation forceps, and at the same moment pressing gently upon the upper and posterior lip of the wound with the spoon. In case this expedient, with such other manœuvres as have already been suggested, does not succeed, the extraction must be effected by the aid of the spoon or hook.

The advantages claimed for this operation of Von Graefe's are, that the wound is made in parts which cicatrize readily, the flap is smaller, the iris is in no danger of protruding, and is less likely to inflame, the lens is more easily extracted, and the wound made by the operation is less conspicuous. On the other hand, there is more care requisite to prevent the escape of the vitreous humor, and hæmorrhage is a more frequent accident. The vision of the operator is also sometimes confused by the admission of irregular rays of light through the disfigured pupil.

Critchett, Arlt, and others modify the method of Von Graefe slightly, by making the incision in the cornea instead of the sclerotica; some surgeons also prefer to make the iridectomy several days or weeks before making the operation of extraction.

The operation of Von Graefe in the hands of its distinguished author, and in the hands of other experienced and skilful specialists has proven remarkably successful; but it is a procedure demanding great delicacy and adroitness of manipulation, and we would advise no surgeon to attempt it until he had already become skilled in the performance of the ordinary flap operation.

Out-Scooping of the Cataract.—By this method it is proposed to remove the lens through a sclerotico-corneal incision, by the aid of a scoop. Like Von Graefe's method, it requires also the simultaneous performance of iridectomy. The operation is adapted only to soft or fluid cataracts; and consists in lacerating the capsule with a broad needle, subsequently introducing through the corneal opening made by the needle a delicate canula, with an extremity formed like the nib of a pen, penetrating the substance of the lens and removing it by suction.

The original suggestion seems to date back to the fourth century, but Mr. Teale has only lately recalled the idea and reduced it to practice. Teale has a suction-tube fitted to the handle of the canula, or "curette," made of India-rubber tubing, and furnished with a mouthpiece, the suction being effected by inspiration. Williams adopts a modification of Teale's apparatus, and Bowman employs for the same purpose a suction syringe.

Depression or Couching. Syn., Depressio Lentis, R. C.—This operation was for a long time the principal alternative for hard cataracts, but it has at the present time almost entirely given place to extraction. Wells says that "although it may appear temporarily successful, it has been found that ultimately about 50 per cent. of the eyes have been lost from chronic irido-choroiditis." In the early part of my practice I made the operation a few times, and my experience fully confirms the correctness of this observation of Mr. Wells.

The operation consists in introducing a needle through the sclerotic coat, about one line posterior to the cornea, and a little below the horizontal diameter, carrying the needle behind the iris and in front of the lens, and then slowly depressing the lens into the vitreous humor.

Reclination is a modification of the preceding operation, in which the lens is tilted or thrown over backwards into the vitreous humor, and then forced down below the pupil. The operation is liable to the same objections as the preceding, and is now considered obsolete.

Accidental Dislocation of the Lens. Syn., Ect opia Lentis.—Dislocation of the lens may be partial or complete; when complete, it may be dislocated into the aqueous or vitreous humor: it may occur as a consequence of a concussion of the ball or other injury, or it may ensue upon anterior sclerotic staphyloma, iritic adhesions, and other abnormal conditions of the eye.

If the lens becomes fixed in its new position, iridodesis may improve vision; if in its abnormal position it causes inflammation, it must be removed by extraction.

Myopia. Syn., Visus Brevior, R. C.

Myopia is, in most cases, the result of a faulty anatomical formation of the eye, the globe being elongated in its antero-posterior diameter, so that the retina lies posterior to the principal focus of the eye. This elongation may be at the expense of the anterior or posterior portion of the globe, or of both; but recent observations have shown that it is generally the posterior portion which is elongated, constituting posterior sclerotic staphyloma. In some cases, moreover, the myopia is probably due to increased convexity of the lens.

Myopia may be congenital or acquired. When due to congenital abnormality of formation, it is but little if at all amenable to treatment. Acquired myopia is, in most cases, a result of using the eyes in the examination of minute objects; by which practice the muscles compress and elongate the globe, causing especially a dilatation of the posterior walls. Other causes may concur in the production of myopia at any period of life, but it is probable that the action of the muscles in the manner just explained is, of all others, the most active and efficient.

Children, and all persons becoming progressively myopic, should be removed from study and from the use of the eyes in the examination of small objects, and especially when the light is imperfect. They should seek out-of-door occupations, and take measures to give vigor to the general system. In the occasional reading which may be permitted, large and distinct type should be chosen; and the clear light of day should be preferred to artificial light.

Concave glasses improve vision in most cases of myopia, but they ought not to be used when the myopia is very moderate. The vision of distant objects requires glasses of somewhat higher power than are necessary for reading and for vision of near objects generally; but for either purpose it is better that the power of the lenses shall be somewhat less than is demanded for distinct vision, rather than greater.

When the retina is very much expanded by elongation and distention of the posterior tunics, accurate vision cannot be restored by any form of lens, since the retina is in such cases attenuated, and vision is thereby rendered weak or confused—amblyopic.

In advancing years vision usually becomes presbyopic, so that those who have had moderate myopia in early or middle life, find, sometimes, their vision sensibly improved as they become older; and they are able to postpone the use of convex glasses much longer than persons whose sight was previously emmetropic or normal.

Hypermetropia. Syn., Visus Longior, R. C.

The power of accommodation of the eye to distinct vision of near or remote objects is a purely physiological quality, and is in most cases voluntary, depending upon the action of the ciliary muscles, through whose agency the lens is rendered more or less convex. In vision of near objects its convexity is increased, and in vision of remote objects it is diminished. For the knowledge of this important fact we are indebted especially to the careful observations of Kramer, Helmholtz, and Donders. Coincident with these changes in the form of the lens, and the consequent changes in its refractive powers, there is also, in the inspection of near objects, contraction of the pupil and convergence of the axes of the two eyes; the slight auxiliary influence of which two circumstances will be easily appreciated.

Presbyopia.

In advancing life the lens gradually hardens, so that its form cannot be changed or accommodated by the action of the ciliary muscle. In most persons at the age of forty, the near point of accurate vision is about eight inches; but it continues to recede, and at fifty years it may be twelve inches. This condition is termed **presbyopia.** In presbyopia there is then a recession of the near point of vision, but not necessarily any change or recession of the far point—the power of accommodation is limited. Often, however, there is added a loss of refractive power in the lens, or a shortening of the axis of the eye, causing the far point to recede also, and this condition is named **hypermetropia.** The latter may exist, also, independently of the former.

Astigmatism. Syn., Astigmatismus, R. C.

Astigmatism is a want of harmony in the refracting powers of different portions of the dioptric apparatus, in consequence of which the rays of light converge at different points, and form linear images at right angles with each other. It is due chiefly to inequalities in the convexity of the cornea; and, perhaps occasionally, to a lack of symmetry in the curvature of the cornea.

There are various methods of testing astigmatic vision, but it will be sufficient, in most cases, to observe the effect of a change in position of a single straight, heavy black line, placed upon a white ground. In the vertical position, for example, it may appear clear and distinct, while in the horizontal position it may appear indistinct, or double. A further confirmation of the experiment may be made by directing the patient now to look at the same object through a slit-like aperture, or through a slit in a metal plate, called a stenopæic disk, when the error of vision will be corrected.

To harmonize the refraction and render vision distinct, cylindrical glasses must be employed—that is, glasses not ground to a uniform convexity or concavity, but supplemented by a cylindrical curve. For their adjustment to any given case, the aid of a skilled optician will be required.

Spectacles and Eye-glasses.

In general it may be considered objectionable to employ single eye-glasses, since they are apt to impair the functions of the opposite eye, by disuse.

Spectacles demand for their proper selection much skill and care. Ophthalmologists generally employ, for the purpose of determining the focal powers and other qualities required in the lenses, "trial glasses," which are supplied in sets, and numbered corresponding to the numbers of similar glasses sold by opticians.

Concave glasses must be near the eye, and convex glasses a little more removed; they must be on the same level, and the centre must correspond accurately to the centre of the pupil.

Periscopic, or concavo-convex glasses, give a wider range of vision, but reflect the light more.

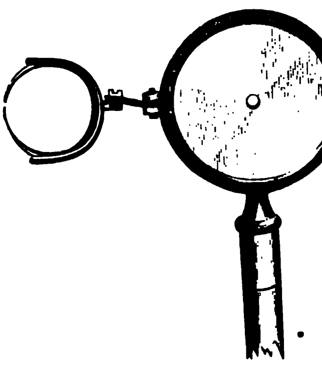
Glasses are constructed having different foci in the upper and lower half, called *pantoscopic*, which are found useful for miniature painters, lecturers, and in general for those who are required to observe in rapid transition near and remote objects.

Eyes which are very sensitive to light require sometimes *eye-protectors*, and the best for general use are curved blue glasses. Goggles and side glasses exclude the air too much. As a protection against small particles of stone and steel, Cohn's mica spectacles, curved so as to form a shield for the entire front and sides of the eye, are the cheapest and best; but those of thick plate glass, with strong gauze flanks, are at present generally employed.

The Ophthalmoscope.

Only a few years have elapsed since Helmholtz contributed the ophthalmoscope; yet already a great number of modifications have been suggested, among which may be enumerated the portable hand ophthalmoscopes of Liebreich, Coccius, Zehender; the stationary ophthalmoscopes of Loring, Liebreich, Smith, Beck; the binoculars of Giraud, Teulon, Laurence, Heisch; and the auto-ophthalmoscope, with which, by an ingenious arrangement of lenses, the operator is able to examine his own eyes.

Fig. 302.



Liebreich's Ophthalmoscope.

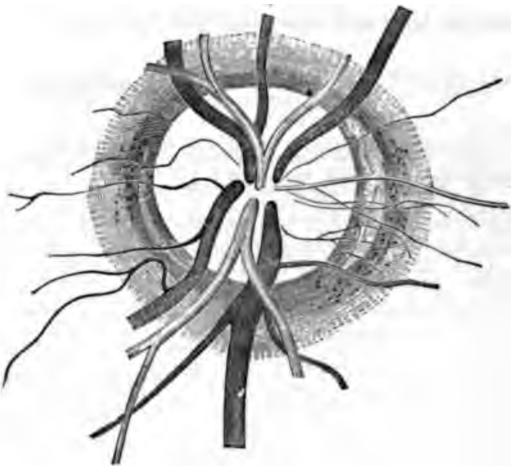
Of all these various forms of ophthalmoscopes, the portable apparatus of Liebreich is in most general use; but the instrument devised by Loring, of this city, is generally preferred by American ophthalmologists.

Liebreich's instrument consists of a concave metal mirror, one inch and a half in diameter, with a focal length of six inches, and a central aperture of one tenth of an inch in diameter. The reflector is supported by a light handle, and has attached to its margin a movable socket, intended to receive, as occasion may require, a convex or a concave lens.

The "direct" method of using this instrument is as follows. The room eing darkened, the patient is seated beside, and a little in front of, a eady and clear artificial light, while the surgeon places himself directly pposite, and, with his ight eye at the aperture f the reflector, directs he light upon the eye of he patient. The retina nay now be seen, giving o the pupil an orange-ed color; and by gradu-lly approaching the mir-or to the eye, the differ-ent portions of the retinal tructure may soon be learly recognized.

The "indirect" method liffers from the direct, nly in the use of an ob-ect glass, as represented n the accompanying ood-cut. (Fig. 302.)

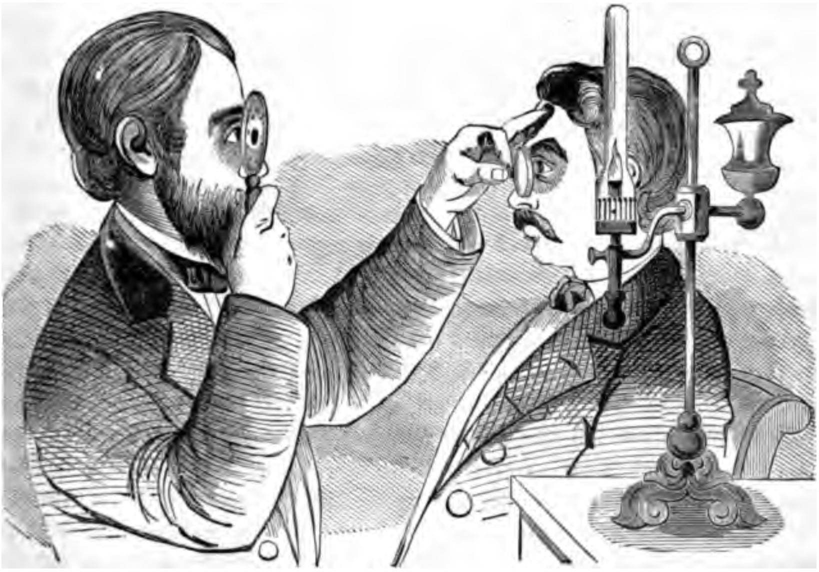
Fig. 303.



Veins and Arteries of the Optic Papillæ.

The supplemental concave and convex glasses, intended for the lip attached to the frame of the mirror, are to be used in case the server is himself myopic or hypermetropic. If myopic, the concave

Fig. 304.



Ophthalmoscopy. Indirect Method.

lens will be interposed between the observer's eye and the mirror; if hypermetropic, the convex lens will be employed in the same manner.

One may easily improvise a very useful ophthalmoscope by punching a hole in the centre of a circular piece of polished tin. A common pocket lens will complete the apparatus.

Test-Types.

Test-types are now generally employed by ophthalmologists to determine various qualities of vision. Those of Jaeger are ordinary printer's type of various sizes, ranging from No. 1, Diamond, to No. 20, 8-line Roman; the numbers 1 or 20 representing the distance at which the corresponding type may be read at a distance of 1 or 20 feet, by a normal eye. Snellen's test-types, which are the best for determining acuteness of vision, are selected letters, arranged without order, in a gradually enlarging series, with numerals attached to each series for the purpose of indicating the distance of distinct normal vision. Hays, Williams, and others have contrived similar scales. Either of these sets of test-types may be obtained from the booksellers, arranged upon cards with explanatory notes.

Exophthalmos. Syn., Exophthalmia; Procidentia Oculi, R. C.; Proptosis.

The term exophthalmia, or protrusion of the eyeball, is properly used to express a symptom or phenomenon common to various affections of the orbit, or of the intra-orbital viscera. Thus, for example, it may be due to the presence of any form of tumor situated more or less behind the globe, to the formation of an abscess within the orbit, to enlargement of the veins and arteries, to extravasation of blood, and emphysema after fractures of the base of the skull, to paralysis of the recti muscles, and finally to simple hypertrophy of the adipose and connective tissues.

Cellulitis Orbitæ.

Inflammation of the deep cellular tissue of the orbit may be acu or chronic. In the acute form the eye not only protrudes at an ear period, but the lids become swollen, and occasionally the ball of the ey itself becomes involved, constituting *panophthalmitis;* even the brai and its meninges are sometimes invaded. Its progress is attended wit much pain, and pretty active febrile symptoms. Pus having forme may evacuate itself through the upper lid, or beneath the conjuncti in front; it may escape into the cavity of the cranium, or into th antrum of the superior maxilla. When panophthalmitis exists, p may form also in the interior of the eye.

The chronic form of the affection, occurring chiefly in strumo patients, is less destructive in its character, and the matter generally makes its way to the conjunctiva or surface of the lid.

In either case the abscess should be first carefully explored with a long, sharp-pointed, narrow knife, and, if a little pus is found to escape, the opening must be enlarged to a sufficient size to permit it to escape freely.

Exophthalmic Goitre. Syn., Bronchocele Exophthalmica, R. C.; Grave's Disease; Morbus Basedowi; Anæmic Exophthalmos.

The causes and pathology of this affection are not yet fully understood. The ascertained facts are, that in certain anæmic patients, or in patients suffering under palpitation of the heart, accompanied, perhaps, with a bellows murmur, with a rapid pulse, dyspnœa, and general nervous excitement, sometimes with dilatation and hypertrophy, especially of the left ventricle, there concurs, now and then, a vascular and pulsating goitre (*bronchocele aneurismatica*) with exophthalmos; which latter appears to be due directly to hyperæmia or dilatation of the intra orbital vessels, especially of the veins, and hypertrophy of the fat and areolar tissues. These conditions of the intra-orbital vessels and tissues have been ascribed to pressure of the goitre upon the cervical vessels, to anæmia, and to irritation of the sympathetic nerve. Either of the two latter opinions afford the most probable explanation. The disease is most frequent in women, especially during and after confinement; in chlorotic girls; after severe constitutional maladies, exhausting labor, and mental shocks. It usually affects both eyes simultaneously or consecutively.

The treatment consists in the use of tonics, nutrients, and especially in the long-continued moderate use of iodine.

Tumors of the Orbit.

Most of the tumors which originate within the walls of the orbit, and outside of the tunics of the eye, are pseudoplasms, belonging to the third class of Virchow's arrangement. Fibromata are not unfrequent; myxomata are comparatively rare; chondromata, yet more rare; osteomata are again more frequent, originating from the walls of the orbit, and they are usually very hard, often like ivory. None of the tumors above enumerated are necessarily malignant, and they may generally be removed with safety, especially when they do not involve or penetrate the roof of the orbit.

Intra-ocular Tumors.

Of intra-ocular tumors, the encephaloid, or glioma of Virchow, is the most common, as it is also the most malignant. It is almost limited to early life, being seldom seen after the fifth year, and in a few cases it has been found to be congenital. Commencing upon the retina, there is early and complete loss of vision in the affected organ. Under the ophthalmoscope it appears, at first, as a spherical or disk-shaped protrusion toward the vitreous humor, of a dull yellow or grayish-white, glistening color, an appearance designated by Beer as the "amaurotic cat's eye." In rare cases it is more vascular, and presents a uniformly red color. There is no evidence that any other form of tumor than the glioma ever originates from the retina.

Sarcoma of the choroid is perhaps next in point of frequency. In its early stages it presents under the ophthalmoscope a dull gray, brownish-red, or blackish color; the darker colors being due to the presence of pigment. Primary sarcoma may become carcinoma. White sarcoma is, like glioma, a disease of infancy or childhood; the pigmented variety may occur at any period.

According to Virchow and Knapp, true primary carcinoma, originating within the ball of the eye, is, to say the least, exceedingly rare. It must be remembered, however, that Virchow gives a very limited and exclusively anatomical definition to the term carcinoma.

Early and complete enucleation of the eyeball is recommended in either of the above-mentioned varieties of intra-ocular tumors. If removed at a later stage, all inter-orbital tissues must be included.

Sichell and Knapp believe it possible that the final retrogressive metamorphosis of encephaloid may sometimes lead to atrophy and a spontaneous cure, and Sichell suggests a plan of treatment mainly intended to diminish nutrition. One might naturally be disposed to adopt this uncertain therapeutic alternative, inasmuch as there is no well-authenticated report of successful extirpation. I have myself, several times, practised removal of all the intra-ocular tissues in these unfortunate cases, but the malady has uniformly returned and my patients have died.

The following additional forms are mentioned by Knapp in his excellent treatise on intra-ocular tumors:[1] sarcoma carcinomatorum; sarcoma of the iris, white and melanotic; myo-sarcoma of the ciliary body; telangiectasis of the iris; syphilitic, gummy tumors of the iris and choroid; tubercles; lipoma of the iris; cysts of the iris; simple melanoma of the iris; and simple granulation tumors.

Excision of the Eyeball.

Ophthalmologists are in error when they assert that only recently have surgeons understood the true method of enucleating the eye; and they are equally in error when they speak of it as "hitherto one of the most formidable of operations." In whatever manner performed, whether by inclusion or exclusion of the extra-ocular tissues, it is absurd to speak it as "formidable," in comparison with a multitude of other surgi operations. I have so often extirpated the eye, by both methods, it I may be permitted to speak authoritatively upon this point.

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[1] *Treatise on Intra-ocular Tumors*, by H. Knapp, M.D., American Ed., William Wood & Co., New York, 1869.

When the disease for which the eye is removed is not malignant, or ıen the malignant product is in the first stage of its progress, and we n be certain that it is limited to the interior of the ball, "enucleation" ɔm its fibrous capsule is practised, by incising the conjunctiva toward e inner canthus, and a few lines from the cornea, dividing the rectus ternus at its attachment, dissecting close to the sclerotic coat until the ıtic nerve is reached, dividing this with curved scissors, then dislo-ting the eye outwards and removing the remaining attachments with e same instrument. If the surgeon prefers, he may divide the attach-ents of all the straight muscles before dividing the nerve and dis-cating the ball. The bleeding soon ceases spontaneously, or it may be ore speedily arrested by cold water affusions.

The advantages of this method over that in which other intra-orbital ssues are included, are, that it is more expeditious, it is attended with s hæmorrhage, and it leaves a muscular and adipose mass, which rms a useful stump for the support and movement of an artificial e.

In case a malignant disease—or a disease of whose innocence a ubt can be entertained—is not known to be limited to the interior the ocular tunics, the entire intra-orbital viscera should be removed. order to accomplish this it may be necessary to enlarge, first, the ternal commissure of the lids. The dissection is then commenced ith strong curved scissors, close to the inner wall of the orbit, penetra ıg rapidly through the conjunctiva to the optic nerve, and then com-eting the operation by extending the dissection to the entire circum-rence of the orbit. If any portions of the muscular or other tissues re-ain, they should be seized with forceps and removed. The bleeding at first quite free, but it may be promptly arrested by filling the bit with pledgets of lint. No ligatures have been required in any erations of this kind that I have hitherto made.

Artificial Eyes. Syn., Prothesis Oculi.

Artificial eyes should not be inserted until after the lapse of several eks, and not until the tenderness resulting from the wound is entirely ıe. At first the eye should be smaller than is intended to be worn manently. It must be removed regularly at night, washed, and not roduced again until morning. When the surfaces become rough m use—as happens generally in the best artificial eyes within six twelve months—a new eye must be substituted. If the eye has been noved on account of sympathetic irritation of the opposite eye, no ificial eye should be inserted until the remaining eye is in a condition perfect health, and has been so for some time.

Opticians are often permitted to receive unreasonable and extortionate fees for inserting an eye, because the applicant entertains a belief that it is an operation requiring great skill and dexterity. The method of inserting an artificial eye is sufficiently simple. The upper lid being gently drawn upwards, the eye is pushed underneath, and then the lower lid is lifted over its lower margin. In removing the eye this procedure is reversed, that is—the lower lid is drawn downwards and a small blunt instrument introduced beneath the eye, when it falls immediately from beneath the upper lid.

CHAPTER III.

SURGERY OF THE EAR.

Deafness, Syn., Surditas, R. C., is in most cases the result of those abnormities, diseases, and accidents of which the writer proposes now to speak.

Congenital Malformations.—The pavilion of the ear may at birth be found adherent to the side of the head; the external ear may be in part or entirely absent; or the meatus auditorius externus may be completely closed. No surgical expedients have yet been devised competent to the relief of either of these deformities. In case the meatus is completely closed, the internal structure has always been found so defective, that nothing could have been gained by the formation of an artificial meatus. In examples of congenital narrowing of the channel, something may, perhaps, be effected, in a certain proportion of cases, by gradual dilatation. Where the complete atresia is caused by a thin tegumentary, or parchment-like septum, its removal by the knife is always practicable. The meatus occasionally becomes narrowed, in consequence of chronic external otitis, or from eczema, or from certain changes in the tegumentary and cartilaginous tissues due to old age, and from exostotic growths, particularly in gouty persons.

Hæmatoma Auris, R. C., Syn. Othæmatomata.—In consequence of a blow upon the ear, blood is sometimes extravasated beneath the integument, forming a purple, elastic tumor. I have seen examples in which the whole integument upon the anterior face of the auricle was so much elevated as to obliterate all the natural irregularities of surface. By some writers this condition has been erroneously considered as a disease peculiar to the insane.

If these blood-tumors are opened at all, the operation should be deferred several days, or until the lacerated vessels have had an opportunity to close. In most cases they have been found to disappear spontaneously in the course of a few days or weeks.

Wounds of the Auricle.—Even those wounds which include the cartilaginous portions of the ear, close very speedily when brought together by numerous fine sutures. It is said that in some instances ears have been successfully transplanted from one person to another.

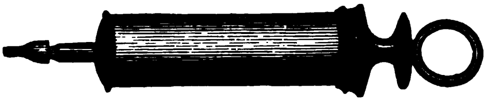
Tumors of the Ear.—Fibroid growths are quite common in the cartilaginous portions, and upon the lobe of the ear, the latter occurring especially in those who wear brass ear-rings, and more frequently in the colored than in the white races. They are usually benign in character, sometimes recurrent, and may be, in most cases, removed without sacrificing the integument, or entailing deformity. More rarely, encysted tumors form in the ceruminous and hair follicles. In 1858 I removed an encysted tumor, of the size of an English walnut, from the lobe of the ear of a young lady twenty years of age. The sac was exceedingly thin, and the contents atheromatous, being composed chiefly of oil globules and epithelium cells. Adipose and erectile tumors, with epitheliomata, are, also, occasionally seen upon the external ear.

In gouty persons it is quite common to find small deposits of urates upon the upper border of the helix, varying in size from a pin's head to a pea. According to Tröltsch, small calcareous or ossific deposits are sometimes found upon the cartilaginous portions of the ears of both young and old persons, who do not possess the gouty diathesis.

Obstructions of the External Meatus from Excess of Cerumen.—The amount of cerumen secreted varies in different persons when in a state of equal health; but from certain causes the amount is sometimes greatly diminished, giving rise to a preternatural dryness of the passage. In such cases, if the cause cannot be reached, we may certainly relieve the uncomfortable sensations which this condition occasions, by moistening the meatus with a very minute quantity of glycerine, conveyed upon a camel's-hair pencil. On the other hand, in consequence, perhaps, of hyperæmia, or of actual inflammation of the meatus, or from other causes, the amount of cerumen may be greatly increased, constituting a true *seborrhœa.* It is probable, also, that this accumulation is often due to narrowness of the canal, or to some accidental obstruction which prevents its escape in due proportion to its formation. Usually the plug is found to be composed, not of cerumen alone, but also of dry epidermic scales, hairs, cholesterine, and perhaps a small piece of cotton or some other foreign substance. In some cases these deposits have acquired such a degree of hardness and bulk as to depress and finally perforate the drum, and to cause other serious changes, both in the auditory canal and middle ear. Sometimes, after removal of the wax, the drum remains depressed toward the middle ear, and may be restored, at least temporarily, by directing the patient to close the mouth and nose and inflate the cavity of the tympanum by blowing forcibly; or by catheterism.

Diligent and repeated syringing of the ear with warm water and the bicarbonate of soda will soften the wax—especially if it has been previously well soaked with glycerine—and sometimes remove it entirely; but usually, after one or two sittings, the surgeon may displace it in mass by the aid of the ear scoop, or by an ordinary silver probe, barbed by notching it near its end. We have seen patients whose ears have been thus obstructed for many years, and, upon the removal of the plug, the drum has manifested such an acute sensibility that the feeblest sounds were unpleasant, or even painful. In such cases, after moistening the ear with glycerine, a pledget of cotton should be laid within the auricle and retained by a bandage.

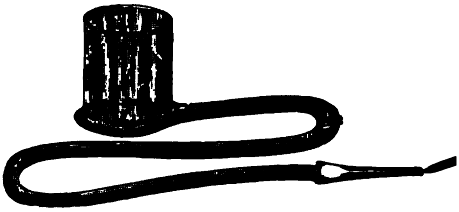
Fig. 305.



Roosa's Ear Syringe.

The syringe employed for the ear ought to have a rather large aperture, in order that the jet may not be too sharp; and the nozzle should have a somewhat abrupt conical form, so that it may not inadvertently be introduced to the tympanum. The four-ounce, hard-rubber syringe, recommended by Dr. Roosa, aurist, of this city, is well constructed in both of these regards. Clark's ear douche will be useful where it becomes necessary to wash the ear often.

Fig. 306.



Clark's Ear Douche.

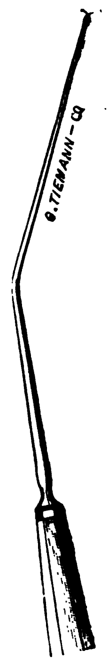
Pustules and **Furunculi** occur in the sebaceous, hair, or ceruminous follicles. They are exceedingly painful, but terminate rapidly in suppuration. The pain may be relieved, and the opening of the pustule hastened, by fomentations of hot water and poppies. If within reach, early incision affords the most prompt relief.

Eczema of the ear, when chronic, is generally due to some constitutional fault, and is, for this reason, exceedingly apt to relapse after being cured. The remedies are, therefore, both constitutional and local. Among the constitutional remedies none are, in general, more efficient than the tincture of the muriate of iron, and quinine, in moderate doses. Solutions of the sulphate of zinc, or of the superacetate of lead constitute excellent local applications. When these have evaporated and the ear has again become dry, it should be moistened with glycerine. Before using the astringents, it is well, also, to wash the ear gently with a weak solution of the supercarbonate of soda in water.

Foreign Bodies in the Meatus.—When insects have made their way into the ear they often cause excessive pain by their motions upon he sensitive tympanum. A few drops of oil, or of warm water, will generally dislodge them speedily. They seem to be equally incommoded by tobacco-smoke. Some years ago a man consulted me, saying hat a fly having got into his ear, he had instantly killed it by pushing in a small stick, and then picked it out; but that within twelve hours he felt something moving in his ear, and in the morning a small maggot escaped; at the end of forty-eight hours, I removed, by the aid of the syringe, thirty-one, each about two and a half lines in length. Dr. Eve, n his "Surgical Cases," describes other similar examples, in one of which the presence of these insects caused convulsions.[1]

When solid bodies are lodged in the ear, such as peas, beans, pieces of stone or of metal, it is sometimes exceedingly difficult to extract them. I have succeeded by a scoop, or a loop of fine wire, but the mouse-toothed forceps have generally proved the most useful. Wilde's polypus forceps is a convenient substitute for the wire. In the case of young children, it is generally necessary to place them under the nfluence of an anæsthetic before making the attempt to remove the obstruction. Whether attempting to remove inspissated cerumen, or foreign bodies, extreme delicacy of manipulation is required; and it is usually safest to convey the instrument along the inferior wall of the meatus. The syringe, with warm water and soap, is often successful, nd its use might always with propriety precede the mployment of instruments. Roosa believes that injections of warm water ought in general to be preferred to any other mode, and that, if employed diligently, they will seldom fail. Tröltsch suggests that, when no other alternative seems to be presented, we hould detach the auricle posteriorly, which will at once bring the bottom of the meatus into view.

Fig. 307.



Elsberg's Screw Hook.

I observe, also, that very lately Dr. Elsberg, of this city, has recommended the use of an instrument, originally invented by Heurteloup for fixating the eyeball, nd which Dr. Elsberg has slightly modified by giving n angle to the shaft, so as to keep the handle out of he way of direct vision. At the end of the instrument re two little prongs curved in the form of the letter in opposite directions, and with which, by a screwing motion, he has been able to seize readily and extract foreign bodies.

Polypi.—Aural polypi generally originate from an cerated surface existing upon some portion of the ning membrane of the auditory apparatus; from the Eustachian tube; the middle ear; the inner, or outer surface of the membrana tympani; or the external meatus. They may also originate from carious bone. It is very seldom indeed that some such lesion, with a prolonged otorrhœa, does not precede their formation. They differ, therefore, in most cases, from other polypi, and might more properly be called fungoid granulations.

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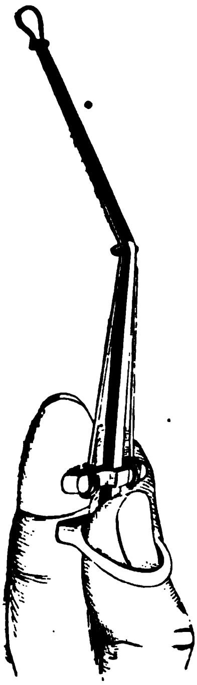
[1] Eve. *Collection of Remarkable Cases in Surgery*, by Paul F. Eve, M.D. Philadelphia, 1857.

They may be made to recede, and sometimes to disappear entirely, by the application of powdered alum, and by various other astringents; but the process of removal can be very much expedited by seizing them with appropriate ear-polypus forceps, when they have originated in the walls of the external meatus; or, if situated more deeply, as is usually the case, by Wilde's polypus snare.

Fig. 308.



Wilde's Polypus Snare.

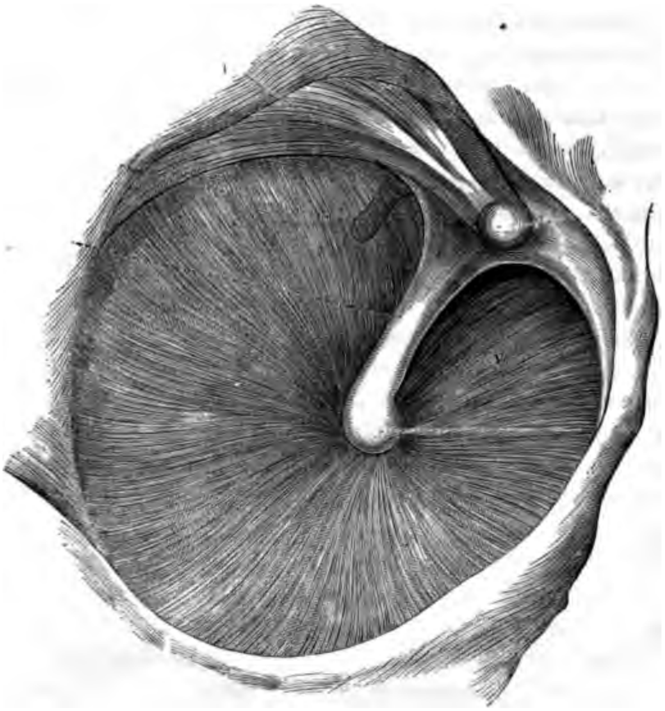
The removal of a polypoid growth, if it accomplishes nothing more, will permit the surgeon to employ injections and other remedies with more effect; and he will not fail, therefore, to avail himself of the period of interval before their reproduction, to make suitable applications.

Inflammation of the External Auditory Canal. Syn., External Otitis; Inflammatio Foraminis Auris, R. C.—This affection is most frequently met with in infancy and childhood, but occurs at all periods of life, in consequence of exposure to cold, and from various other causes. The inflammation usually extends to the outer covering of the tympanum, and to the periosteal lining of the auditory canal, thus exposing the patient to the danger of a perforation of the drum, and to the possibility of caries or necrosis. In some few cases, also, the inflammation is conveyed through the thin bony wall to the meninges of the brain, causing effusions and death. Usually the inflammation subsides in two or three days, and a more or less severe otorrhœa ensues.

As a local means of allaying the pain and abating the inflammation, there is nothing better than filling the external meatus with warm water, or warm water and morphine; applying at the same time, over the auricle, a fomentation made of several thicknesses of sheet lint, saturated with hot water. Leeches, if employed, should be applied in front of the ear.

Otorrhœa.—Otorrhœa is a symptom or sequence of many forms of aural affections, and cannot be considered as a distinct malady. Upon whatever cause it may depend, it demands the frequent use of the syringe, or douche. The water employed should always be warm, and may commonly be softened with a little soda. Otorrhœa, in its later stages, usually requires the use of mild astringents, which, in order that ey may prove effective, ought to be dropped into the ear after it has een thoroughly washed, and while the patient is lying upon the op- osite side of the head. After the lotion has had time to take effect, the eatus should be gently moistened, not drenched, with glycerine.

Fig. 300.



External Surface of the Membrana Tympani, through which is seen the Manubrium Mallei.

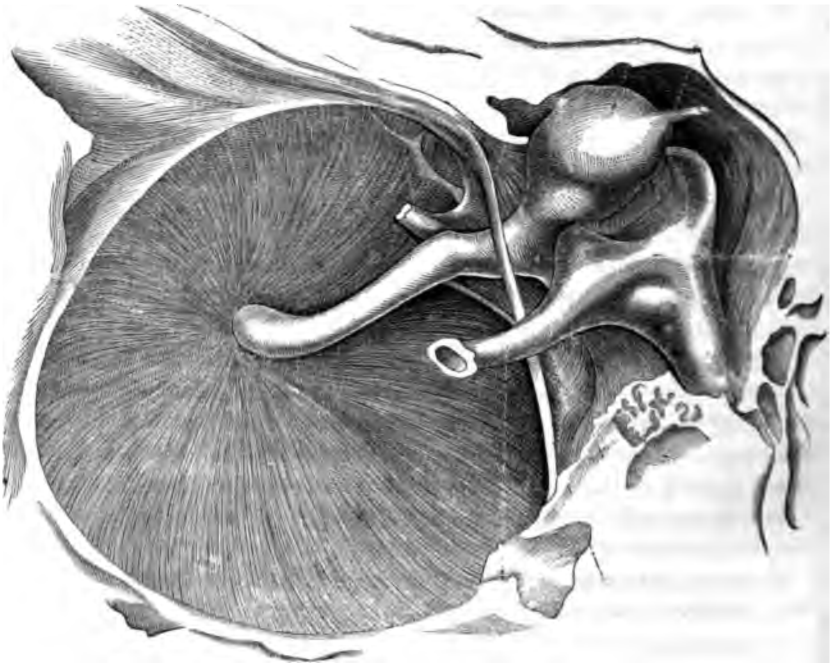
Diseases, Injuries of, and Operations upon the Drum.

Inflammation of the Drum. Syn., Inflammatio Membranæ ympani, R. C.; Tympanitis; Myringitis.—Inflammation limited to e membrana tympani may occur as a primary affection from local inju- es and perhaps from other causes. It is characterized by the sudden- ss of its accession and the great severity of the pain. The danger of per- ration of the drum in these cases is so imminent, that it is proper to join upon the patient the necessity of avoiding even to blow his nose to sneeze, lest the membrane should be ruptured by the outward essure of the air. The treatment is the same as that already directed r external otitis.

Puncture of the Membrana Tympani. Syn., Paracentesis Tym- ni; Myringodectomy.—In cases of myringitis followed by abscess, examples of acute internal otitis, or of otitis media, where large accu- ulations of mucus or of pus have taken place within the middle ear, this membrane is occasionally punctured by the surgeon for the purpose of giving exit to the fluid and affording relief to the intense pain. For this purpose I have employed an ordinary, straight, pointed cataract needle, or a narrow tenotomy knife, and have reasons to believe that the patients were, in some instances, permanently benefited; but as a remedy for obstructions of the Eustachian tube, thickening of the membrana tympani, tinnitus aurium, and for those various other affections of the ear for which it has been occasionally recommended, there is no reliable evidence of its value. Usually the operation is not very painful, nor is it generally followed by much reaction. In most cases the opening closes speedily, even when a portion is excised. In vol. xvi. of the *Lancet*, a case is related of speedy death ensuing upon the pricking of the tympanum with an ordinary needle; a circumstance which may at least admonish us not to make this operation inconsiderately.

Injuries of the Membrana Tympani.—The drum of the ear is frequently perforated by ulceration, and sometimes by the pressure of hardened cerumen; it has been ruptured, also, by the sharp jet of a syringe, by pins used to clean the ear, by surgeons in the unskilful use of the probe, by the injudicious use of the nasal douche, by a blade of straw, by blows upon the head, and by the concussion caused in diving. Dr. Roosa has seen it ruptured by the explosion of a pistol, and many cases have occurred in which the rupture has been caused by the explo-

Fig. 310.



Internal Surface of the Membrana Tympani, with Ossicula, and Chorda Tympani. Gruber.

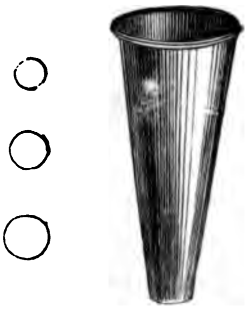
n of cannon. It has happened to me, however, to meet with only a ry few examples resulting from the discharge of cannon during the e war.

When the drum is ruptured by concussion, the line of rent is usually sterior to, and parallel with, the handle of the malleus. Many of ese wounds, also, speedily close; but in case they do not, the hearing not of necessity seriously affected. Where very considerable deafness sues, it is proper to infer that the deeper portions of the auditory pparatus have been involved in the lesion.

Fracture of the Handle of the Malleus.—This curious accident as been observed several times, and in one case by Dr. Weir, of this ity. In most or all the cases, it has been connected with a rupture of ne tympanum. Generally the wound of the drum has ultimately closed, ut the fracture has remained ununited. The precise influence of this sion upon the hearing is not determined, but probably it is slight. o treatment has yet been suggested.

Otoscopy.—Occasionally the meatus auditorius may be satisfactorily nspected by exposing the ear to the light in such a manner that the sun's ays shall fall directly upon it, while at the same moment the ear is rawn upwards and outwards; but if the channel narrow, or unusually tortuous, or obstructed hairs, it will be necessary to employ a speculum.

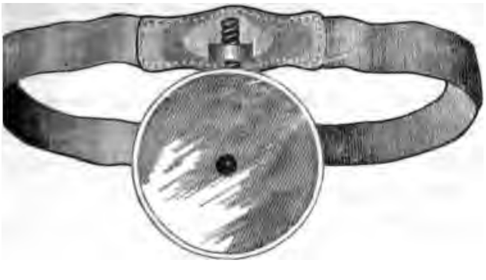
Fig. 311.



Wilde's Aural Speculum.

An excellent and very simple speculum is the all silver tube first introduced by Wilde and commended by Gruber the elder, Roosa, and hers. The surgeon, to be well supplied, ought be furnished with three or four of these tubes different sizes. Through the speculum, when refully adjusted, the light may now be thrown the aid of a concave glass mirror, held in the nd or secured upon the forehead. The centre the mirror should be perforated, or the quicksilver removed at this int, in order that it may be used also by the hand; and when employed in this manner, the surgeon will inspect the canal through the central perforation. The diameter of the mirror needs to be about three inches—which is larger than that generally employed in ophthalmoscopy—with a focal distance of 5—6 inches. In employing this instrument ordinary dif-

Fig. 312.

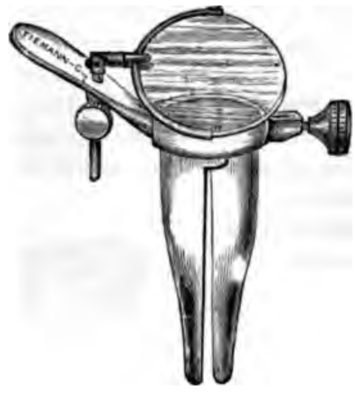


Roosa's Aural Reflector.

fused daylight is to be preferred to very bright and direct sunlight, or to gaslight.

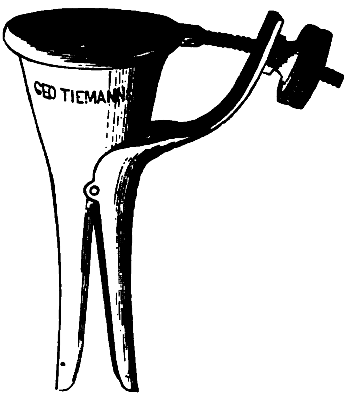
A modification of the well-known reflecting and illuminating otoscope, invented by Hutchison, has been made by Dr. Gabriel Grant, of this city, which may often be employed with advantage. The adjustable bi-valve speculum invented by Simrock, of New York, and the self-sustaining speculum, devised by Spier, of Brooklyn, will be found useful modifications of Wilde's instrument; but in most cases I have found the simple instrument delineated in Figure 315, and which may be designated the "hand otoscope," answer every purpose.

Fig. 313.



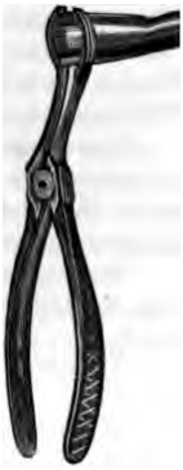
Simrock's Adjustable Otoscope.

Fig. 314.



Spier's Self-Sustaining Otoscope.

Fig. 315.



Hand Otoscope.

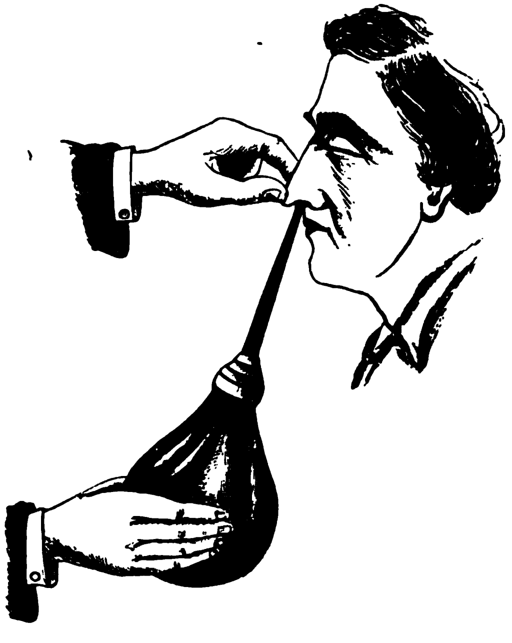
Inflation of the Cavity of the Tympanum through the Eustachian Tube.—The purposes for which inflation is practised are:—First, diagnosis; in order that the permeability of the tube may be determined; and in order that with the diagnosis tube—applied at the same time to the external ear—or by inspection with the reflector, the condition of the middle ear may be ascertained through the medium of its various râles, and also the movements of the ossicula and of the tympanum. Second, treatment; that is, for the purpose of removing secretions from the tube and middle ear, overcoming slight adhesions of the tube, and preparing the way for the introduction of medicated fluids or vapors, etc.

Inflation may be accomplished by a silver or a flexible catheter passed, through the inferior meatus of the nose, into the orifice of the Eustachian tube; the air being driven in by compressing an India-rubber bag adjusted to the outer extremity of the catheter.

Toynbee objects to this method, although it is adopted by most other otologists. The instrument sometimes causes severe pain, and in several instances the air has been forced into the areolar tissue beneath the ucous membrane, causing emphysema; and the empiric Turnbull, of ondon, is said to have lost two patients from the use of the Eustachian atheter. It is almost totally inapplicable to children, on account of heir extreme sensitiveness, and because of their apprehensions. I have o doubt, moreover, that its injudicious employment may have sometimes caused a rupture of the drum. Nevertheless, such is the importnce of this instrument as a means of diagnosis, and of so much value is t believed to be in facilitating internal medication, that it continues to be employed constantly by most experienced otologists.

Politzer, of Vienna, introduces the nozzle of a gum-elastic bag into the nares, and compressing the alæ with his thumb and fingers, directs the patient at the same moment to swallow. The act of deglutition lifts the velum palati, and opens the mouth of the Eustachian tube, thus enabling the curent of air, or of fluid, to ass more directly into the ar. In children, the orice of the Eustachian tube eing much larger than in dults, it is not necessary direct them to swallow hile the air is being incted.

Fig. 316.



Politzer's Method.

Gruber has modified the actice of Politzer, by dicting a current of water to one nostril while the her is closed, and the ad bent forwards; when, the case of children, me of the fluid will genally find its way into the rresponding Eustachian tube. In adults, it is recommended to close th nostrils and the mouth, and to direct the patient to make a modate attempt to blow while the current is passing in.

Finally, Valsalva recommended that the patient should simply close e mouth and nose and thus inflate the tube himself. This method is e simplest, and will sometimes answer all purposes, but the extent of application is limited.

Inflammation of the Internal Ear. Syn., Inflammatio Auris terioris, R. C.; Otitis Interna; Otitis Media.—*Catarrhal vaty.* Acute internal otitis, of the catarrhal variety, is characterized most cases by the concurrence of pharyngitis; by deep-seated and acute pain, increased by swallowing; by very considerable impairment of hearing, the accession of which symptom is usually sudden; by loud and thumping noises; tenderness about the mastoid process, and generally by febrile disturbance. In addition to these signs, there is the negative evidence furnished by the absence of most of those symptoms which usually accompany external otitis and myringitis. The symptoms are sometimes sufficiently grave to be confounded with those belonging to meningitis.

Tröltsch advises the early inflation of the middle ear by means of the catheter; and Schwartze recommends puncture of the membrana tympani. Both of these expedients may, in my opinion, be better reserved for extreme and exceptional cases, where the integrity of the drum is seriously threatened.

In a majority of cases the malady soon yields to such remedies as rest in a warm bed, moderate catharsis, warm fomentations, pediluvia, and leeches applied to the tragus.

When internal otitis assumes the character of a chronic catarrh, the symptoms become essentially modified and subdued; but certain permanent changes are liable to be induced in both the middle and internal ear, as well as in the Eustachian tube, resulting in serious deafness.

The treatment of internal otitis of a chronic form consists in the injection of medicated vapors and fluids; in inflation with simple air; in dilatation of the Eustachian tube, for the purpose of gaining free admission to the ear; in the use of gargles, excision of enlarged tonsils; finally, and most important of all, in the improvement of the general health. All the other measures may, in certain cases, be safely omitted, but this cannot be in any case. Air, exercise, and nutritious food, must always be regarded as essential therapeutical elements in the successful treatment of this very common and, usually, very obstinate affection.

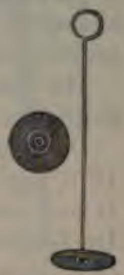
Internal Otitis of the Purulent Variety.—More rare, and more severe in the character of its symptoms and in its results, this variety may be confounded with either myringitis or meningitis. It may terminate in perforation of the drum, in complete detachment of the ossicula and destruction of a large portion of the internal apparatus of the ear, incaries and necrosis, and, finally, in almost absolute deafness.

The treatment in its acute stage is essentially the same as that already indicated for acute, catarrhal, internal otitis; and in the later stages injections of medicated vapors and waters are appropriate remedies.

Artificial Membrana Tympani.—In cases of perforation of the ear, hearing is sometimes much improved by the introduction of an artificial drum, composed, in the case of Toynbee's instrument, of a thi disk of vulcanized rubber, to the centre of which a fine silver wire i attached for the purpose of carrying it to its position and for i removal.

Lucal, of Berlin, prefers a rubber tube, to which the disk or artificial drum is attached by a solution of gum arabic. Politzer uses for the poor a bit of rubber, four or five lines in length, by one and a half to two in thickness, fastened to a wire. A ball of moist cotton pressed against the drum will sometimes serve the same purpose. One condition of success with all these measures appears to be, that a certain amount of moisture shall be interposed between the artificial and natural drum. Nor must the surgeon be disappointed, if, when all the conditions seem most favorable, no improvement in audition results; since experience has shown that the effects of the application of an artificial drum are capricious and uncertain. The same measures, also, will occasionally improve the hearing when there is no deficiency or rupture of the drum.

Fig. 317.



Toynbee's Artificial Drum.

Nervous Deafness.—In relation to this form of deafness, I might content myself by saying that it is as yet very little understood. We cannot yet decide how many cases of deafness depend originally and exclusively upon affections of the auditory nerve, including its terminal expansions within the labyrinth. We may, indeed, decide upon intracranial disease, or lesion, as a cause of nervous deafness; we recognize narcotism, cinchonism, concussion, syncope, anæmia, disuse, old age, lead poisoning, as sources of temporary or permanent paralysis of the nerves of hearing; but when we come to inquire what are the signs indicating changes in the anatomy, structure, and contents of the internal ear, involving—as such changes must necessarily—changes in the conduct of the auditory nerve, we are almost completely in the dark. In fact, if we are ever able in such cases to make a satisfactory diagnosis, it is only by exclusion. We assume the existence of morbid changes in the internal ear, because there are no changes in the middle or external ear, or recognized intra-cranial lesions, which will sufficiently explain the degree and quality of deafness. Total loss of hearing will always imply a complete suspension of the functions of the nerve, but it cannot teach us the pathological conditions which have enforced this suspension of function.

Nervous deafness depending upon anæmia, demands nutrition, tonics and stimulants; the atrophic paralysis of old age may possibly be benefited by electricity or galvanism; and in certain other forms of impaired nervous function, the source being clearly observed, the intelligent surgeon will have no difficulty in choosing his remedies.

Tinnitus Aurium.—All abnormal sounds have reference directly or indirectly to the condition of the auditory nerve. They may be exaggerations of natural motions or impulses, as when the arteries pulsate with unusual force; they may be due to an exalted sensibility of the auditory nerves, in consequence of which normal impulses cause exaggerated sensations; new or abnormal motions may be present, such as mucous râles, or vibrations of loosened ossicula; the ossicula may be anchylosed; the mucous membrane may be thickened; and finally, as is probably most often the case, they may be entirely subjective, and analogous to those scintillations or waves of light seen by the over-sensitive retina in the dark.

The treatment of tinnitus aurium comprises the treatment of the entire class of aural affections.

Dr. Politzer brought before the Medical Society of Vienna, in June, 1870, a girl from whose left ear a rhythmical ticking could be heard. It had continued five months and was not interrupted during sleep. Dr. Gruber, who was present, thought the ticking was due to the action of the tensor tympani, since some persons have the power of causing this contraction, accompanied by an audible sound, voluntarily; but this girl had no control over the sound, and Dr. Politzer believed that in her case it was caused by a spasmodic action of the tensor palati upon the Eustachian tube, drawing the mucous portion of the tube from the cartilaginous part.

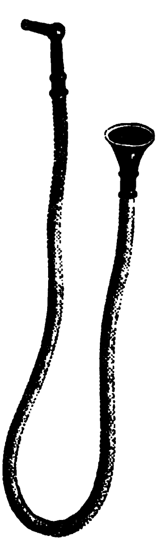
Otalgia.—A purely nervous affection of the ear, uncomplicated with inflammation, is occasionally observed. It may consist in hyperæsthesia of the tympanic plexus; or it may be a reflex nervous sensation, due to disturbance of the stomach, or of other viscera supplied by the pneumogastric nerve. Most often it arises from caries of some of the molar teeth.

In addition to the removal of the cause, whenever it is practicable to do so, relief may be obtained by a bag of bran or of poppy-heads, steeped in hot water and applied over the ear, or by dropping into the ear warm or hot water, with or without one or two drops of laudanum.

Deaf-Mutism.—Congenital deafness is generally due to certain abnormities in the formation or development of the auditory apparatus; but deaf-mutism is often acquired, being probably, in most of these latter cases, a result of disease existing subsequent to birth. In an examination of 296 cases, made by Drs. Roosa and Beard, of this city, 182 seemed to have been congenital, and 114 acquired. Whether the deafness be congenital or acquired, it is probably, in a large majority of cases, not at first absolute, but only so feeble that the subjects of it do not hear with sufficient distinctness to be able to imitate articulate sounds. Deafness which is not in the highest grade at first, will, however, become in most cases absolute, by long-continued disuse of the organ. These facts are of great practical importance, since it must follow that early and assiduous attempts to secure the attention of the child to articulate sounds may sensibly improve the power of audition, and sometimes establish or restore the speech; and that the omission to do so will eventually result in such a complete atrophy and anchylosis of certain portions of the auditory apparatus as must render the case wholly incurable.

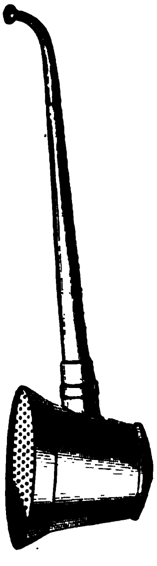
I have seen several cases of *Mutism* in children unaccompanied with leafness, or with defect of any portion f the vocal apparatus. Notwithstanding hat the parents in all such cases have egarded their children as possessing averge intelligence, and sometimes have ven spoken of them as precocious, it has lways been to me apparent that their ntellectual faculties were solely at fault. 'hese were not, however, examples of iental imbecility, but of tardy intellectal development; and in the case of such hildren it is quite certain that the faclty of speech will sooner or later be acuired. Nor must they be confounded ·ith examples of partial deafness, acompanied with a habit of inattention, ·hich may also lead to a delay in the foriation of articulate sounds.

Fig. 318.



Conversation Tube.

Fig. 319.

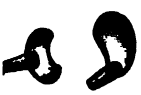


Dipper Trumpet.

Ear-Trumpets.—Contrary to what is he popular belief, a pretty large proporion of persons affected with deafness deive no benefit whatever from ear trumpets of any form. That which rill be found most generally useful is the long "conversation" tube, nade of coiled wire, covered with India-rubber, or stranded leather, and rith extremities made of horn.

Metallic trumpets are too resonant, and gutta-percha deadens the ones. None of the small metallic auricles, made to be worn permaently, are of any value. Webster, of London, has, however, invented what he calls an "otophone," which is placed behind the ear, and, by pressing the auricle forwards, increases its capacity for receiving and transmitting the sonorous impulses. When the ear lies flat against the side of the head, or inclines too much backwards, this instrument may serve a useful purpose. Small silver tubes or "coriets" are useful only in cases of contraction or polypoid obstructions f the meatus.

Fig. 320.



Silver Cornets.

Metallic trumpets are not so useful in conversation as tubes, being —as already stated—too resonant, but they are preferable when listening to a public speaker. They are constructed in various forms, but we have seen no instrument that is so powerful as the "dipper" trumpet.

CHAPTER IV.

SURGERY OF THE NOSE.

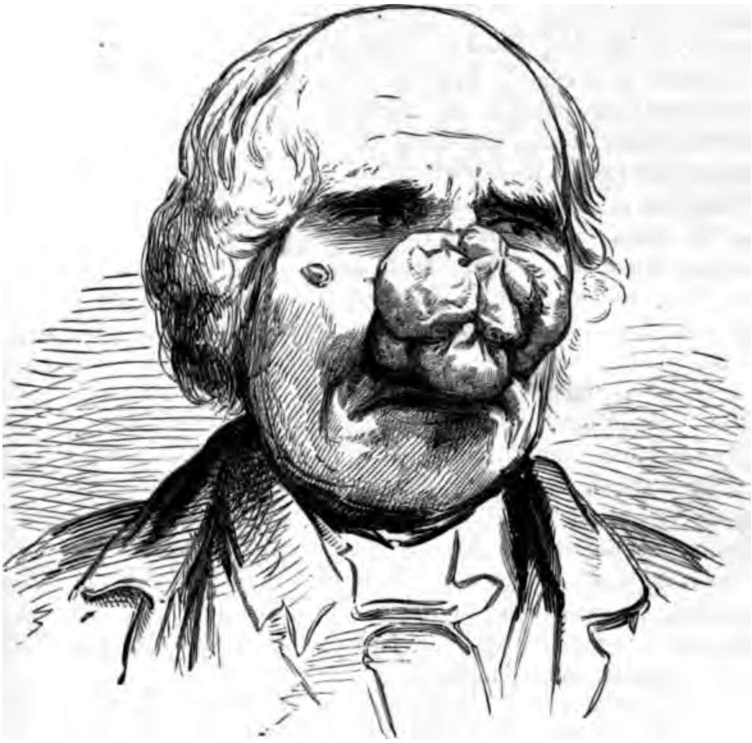
Congenital Malformations.—The septum nasi is sometimes inclined to the right or left, or it is bent in its centre to the one side or the other; and as age advances these deviations from the perpendicular occasionally cause annoying obstructions. In some instances it has become necessary to excise a portion of the projecting septum.

There is also occasionally seen, in the imperfectly developed fœtus, a shortness of the nasal prominence, denominated *Brachyrhynchus*, and which is ascribed to imperfect development of the intermedial maxillary bones. Maisonneuve has reported one example of congenital absence of the nose; and by the courtesy of my colleague, Dr. McCready, I have recently been permitted to see another similar example.

Hypertrophia Nasi, R. C.; Hypertrophy of the Integument Covering the End of the Nose, commonly denominated **Lipoma,** is occasionally observed in old people, more frequently in men than in women, and more often in those who have been free eaters than in free drinkers. The end of the nose assumes a red or purplish hue, becomes brawny, bosselated, and the sebaceous follicles, which are enlarged, secrete abundantly. It is never malignant. According to Imbert de Lonnes, a mayor of Angouleme had a tumor of this character weighing two pounds, which hung down as far as the chin.

In 1845, the author met with a remarkable case occurring in the person of a lady aged forty-five, residing in Palmyra, N. Y. Her habits of eating and drinking had always been temperate. Her nose became affected with acne simplex when twenty years old, but the hypertrophy dated from a period thirteen years later, after a blister had been applied to cure the acne. A few years later the lipoma was partially removed by a surgical operation, but it soon attained a larger size than it had before. When she consulted me it was a huge bulbous mass covering th lower third of the nose including the alæ, and falling over the mou It was of a dark-red color; some of the sebaceous follicles were of size of a crow-quill, and they constantly exuded a very offensive ma t She suffered much from a sense of heat and weight in the nose, from continued headaches. I carefully dissected away all of the hyp trophied tissues, exposing completely the cartilages of tho ridge of t nose and of the alæ. It was necessary in this case, as it will be fou be in all cases, to keep the forefinger of the left hand much of the ime within the nose, to avoid the danger of cutting through. Six eeks later cicatrization had made considerable progress, and after everal months I was informed that the cure was completed.

Fig. 321.



Lipoma of the Nose.

If the amount of integument which has to be removed is very great, would advise immediate repair of the lost tissues by transplantation om the forehead. The vessels are generally so much enlarged as to use a pretty free hæmorrhage during the operation; and Gibson states at Mr. Blizzard once lost a patient from this cause.

Epithelioma of the Nose. Syn., Carcinoma Cutis Nasi, R. C.—ithelioma of the nose, seldom seen prior to the thirty-fifth or fortieth ar of life, commences usually upon one of the alæ; next in point of quency upon the side of the nose, in the neighborhood of the inner thus; occasionally it attacks primarily the end of the nose; and, al-ugh obstinate and perforating ulcers are often found upon the lining nbranes, and especially upon the septum they have seldom the racter of true epithelioma.

Upon the integument it appears first as a warty excrescence, or as a all brown crust, accompanied with slight subcutaneous induration.

It may be many years after the first appearance of the crust—which is only degenerated epithelium—before an ulcer is actually formed; and its subsequent progress is usually slow, but steady. In a few examples, epithelioma of the alæ commences as a small, hard tubercle, indicating its origin in a sebaceous follicle.

Treatment.—The successful treatment of epithelioma nasi demands complete destruction of all the tissues embraced in the induration. This may be accomplished by caustics, such as the zinc-paste, or the acid nitrate of mercury, applied every four or five days; but these remedies are slow, painful, and uncertain. It is better to excise the diseased structures freely, including the whole thickness of the alæ; and to supply the loss of tissues immediately by transplantation, either from the forehead or face, in a manner which will presently be described, when we speak of the various rhinoplastic operations.

Lupus Nasi, R. C.; Syn., Noli me tangere.—Lupus attacks primarily the nose more often than any other portion of the body, especially that form of the malady from which its name was originally derived, namely, "lupus exedens." It may be caused by an injury of the nose, as we have seen happen twice, in men otherwise perfectly healthy; but in most cases its cause cannot be ascertained. It attacks, indifferently, the bony, mucous or tegumentary tissues; occurring most often in persons past the middle of life. In the early stages of its progress it cannot usually be distinguished by any local signs from syphilitic ulceration and necrosis; but it is less amenable to treatment, and its ravages do not cease upon destruction of the nose, the ulceration continuing, in most cases, to progress in every direction, until an enormous chasm is formed, and the patient dies worn out, apparently, by simple irritation and exhaustion.

I have seen at Charity and Bellevue Hospitals a large number of these cases, but, with one exception, I have never found any local or constitutional remedies prove useful. In the single instance to which the above reference is made a cure seemed to be effected, after a fruitless trial of various other remedies, by the application of the oxide of zinc ointment.

Strumous Ulceration and Necrosis of the nose is sufficiently distinct from true lupus. It occurs chiefly at or before the period of puberty, in highly strumous patients, and, like syphilitic necrosis, ceases spontaneously after the destruction of the more spongy nasal bones is completed, or its progress is thereafter much retarded. It is, moreover, amenable to treatment. We have recently arrested the progress of a case at the Charity Hospital in a girl fourteen years of age by large doses of the iodide of potassium; twenty grains given three times daily being the average dose. It is possible that careful observation may hereafter show that this variety of ulceration depends upon hereditary and constitutional syphilis, but we have not been able to confirm such a suspicion by any case we have seen.

Syphilitic Necrosis and Ulceration.—As one of the tertiary phenomena of syphilis, this may be distinguished in most cases from either of the other forms of nasal maladies, by its history, concomitants, its amenability to treatment, especially to mercury, and by the fact that it invades primarily the mucous membranes, the periosteum and the bones. (See Syphilis.)

Simple Ulceration, leading to perforation of the septum, is seen pretty frequently in apparently healthy adults. Its progress is slow, and seems to be generally self-limited, since we have never seen a case in which the ulceration did not cease after the destruction of a small portion of the septum; nor has it ever caused deformity of the nose. Cases are reported, however, in which similar ulcers, occurring within the alæ, have resulted in their destruction. Sir Astley Cooper speaks of these ulcers as originating in the sebaceous follicles; and Mr. Ure, recognizing the correctness of Mr. Cooper's observation, remarks, moreover, that they are originally small tubercular elevations, which subsequently undergo ulceration, and he has named them "erosive ulcers of the follicles."

The local treatment consists in the careful destruction of the ulcer with its indurated margins, by caustics. The constitutional treatment must be adapted to the condition of the patient.

Thickening or Hypertrophy of the Mucous Membrane, very common in strumous children, we have known to be mistaken for a polypus; and in one case, where this thickening existed chiefly upon the free margin of the middle turbinated bone, a surgeon had tried ineffectually to seize and remove it with forceps.

It demands only invigorating constitutional treatment; under which plan a gradual recession of the hypertrophy generally takes place.

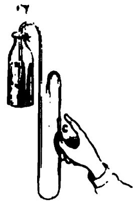
Catarrhal Rhinorrhœa. Syn., Coryza.—This condition often accompanies that of hypertrophy, just described, although it may exist independently. It is, in most cases, the result of a cold, and is then usually transient; but, before terminating, it may invade the frontal sinus, causing severe supra-orbital pains and offensive yellow or greenish discharges. When chronic, we have found the symptoms improved, and occasionally the malady cured, by a snuff composed of ox. hyd. rub. gr. x.; sach. alb. ℥ iv., used three or four times daily.

Strumous Rhinorrhœa, Syn., Ozæna, commences generally in early life, and is most frequently noticed during the period of teething. The discharge is usually abundant and often very offensive, leading to a suspicion, perhaps, that the bones are affected. It is well to understand that such may be the ultimate result; but the offensive odor, from which it has received the name of "ozæna," does not generally imply disease of the bones, nor indeed ulceration of the mucous membrane.

Treatment.—These cases require daily cleansing of the nostrils with the douche; the water employed being tepid, and medicated with a minute quantity of the chloride of zinc, or of carbolic acid, or with some other sufficiently dilute antiseptic.

In the case of adults, when it is necessary to use a nasal douche for the purpose of cleansing the nostrils, or treating them with medicated liquids, we may employ any one of the various forms of apparatus contrived for this purpose; but none are more simple or efficient than the apparatus devised by Potter. For the purpose of cleansing the nostrils we use, commonly, a solution of salt in water, of the proportions of one drachm to the pint. Having placed one end of the syphon in an elevated vessel containing the fluid, the patient, standing with his head bent over a basin, compresses the bulb between his thumb and fingers, and then allows it to expand while the forefinger closes the orifice. If, now, the patient lowers the head sufficiently, the fluid will flow through one nostril and out of the other.

Fig. 322.



Potter's Nasal Douche.

In some cases recently reported, serious accidents have happened from the use of the nasal douche, on account of the diversion of the fluid into the Eustachian tube and internal ear, causing inflammation of the ear, a rupture of the drum, etc. To avoid this occurrence the patient must not swallow, or attempt to speak, while using the douche, and he must stand with his head inclined neither to the right or left.

Abscess of the Septum is of rare occurrence. Evacuation by the knife is sufficient for its cure in acute cases. Chronic abscesses of this character sometimes occasion absorption and perforation of the cartilage. They demand in most cases constitutional treatment; and after they have opened, the remaining ulceration must be treated with stimulating ointments and medicated solutions.

Foreign Bodies in the Nose.—Children often crowd peas, beans pebbles, and other substances, into the nostrils, which, in most cases, become impacted in the lower meatus; but sometimes they are thrust upwards, and may rest above the lower or middle turbinated bones.

They may be dislodged, occasionally, by causing the child to sneeze. If situated pretty well forward, a bent probe or a hair-pin may disengage them. We have several times succeeded with a pair of delicate mouse-tooth forceps. In case the child is very impatient under the attempt to extract the foreign body, it will be advisable to put him under the influence of ether; and finally, if it cannot be brought forward, it will be proper to attempt to push it back into the pharynx; but this should not be done while the patient is under the influence of an anæsthetic, lest it should unfortunately be drawn into the trachea.

Rhinoliths. Syn., Rhinolithi, R. C.; Nasal Calculi.—Occasionally, but very rarely, calculi form in the nares. It is stated that they may form in the frontal sinus or antrum, and subsequently pass into the nares. Usually they originate in some portion of the nasal passage in consequence of the presence of a foreign body, which serves as a nucleus for the calcareous deposits. Their form is determined by the form of the space in which they are lodged. The surface is generally uneven and discolored; and they consist, usually, of the phosphates and carbonates of lime and magnesia, with mucous or other animal matter in addition to the nucleus.

Their slow formation and concealed positions are apt to lead to many errors of diagnosis; but careful examination with the probe, and the characteristic sensation communicated by a calculus, will determine the nature of the malady, and the remedy.

Their removal is to be attempted in the same manner as has been directed for the removal of other foreign bodies from the nares.

Nasal Polypi. Syn., Polypus Nasi, R. C.

Nasal polypi present three very distinct varieties, namely, the gelatinous, the cystic, and the fibrous.

Gelatinous. Syn., Polypus Nasi Glutinosus, R. C.; Mucous; Cellular; Soft.—This variety, which may be regarded as the only true polypus, is much the most frequent. It is seen most often in middle life; rarely in childhood or in advanced age. The progress of a soft polypus is usually slow and insidious, the patient not being aware of its existence until it has attained considerable size. He observes only a gradually increasing obstruction of one or both nares, attended with some excess of mucous secretion; the obstruction being greater in damp weather, and when he has a slight cold. At length his attention is attracted, after forcible blowing of the nose, to a smooth, whitish, soft substance near the external orifice of the nares, which may again recede, and for a time disappear from view. Its structure is homogeneous, being composed of hypertrophied mucous membrane and submucous areolar tissue, infiltrated with a muco-serous fluid.

There may be but one polypus, somewhat oval in shape, flattened on its lateral walls, and attached to the membrane from which it springs by a relatively narrow, and somewhat elongated pedicle; or it may be composed of several lobes or outgrowths united by a common pedicle, having a pretty broad base.

Frequently, there coexist several distinct polypi, with separate points of attachment, or both nares may be found occupied simultaneously with polypoid growths. A remarkable uniformity is observed as to their points of origin; by far the largest majority growing from the free margin of the inferior turbinated bone; next in point of frequency they project from the middle turbinated bone; occasionally from the higher portions of the nares; and it is said that they have been found, sometimes, originating from the frontal sinus or antrum, but they never grow from the septum.

he most satisfactory results—the relief being always more ıe bleeding less, and the polypi have not, as has happened so er cases, been reproduced.

noose may be employed in the following manner:—Through lver canula of four or five inches in length, a piece of an- wire is passed, so as to form an open noose at the farther f the canula. Thus armed, the canula is carried along the nares, until the noose can be felt in the pharynx, where it ed with the first and second fingers of the right hand and e widely. The canula is then carefully withdrawn, in such ıat the noose will slide along the turbinated bone, from be- ds; if any resistance is felt the wire is held steadily in place, ula pushed back, until the neck of the polypus is seized, and made fast over the wings of the canula. By torsion and the avulsion is now completed. This method is especially ıs when the polypus is large, or situated far back.

polypus is too large to be extracted through the anterior, ized through the posterior nares by a strong, well-serrated, y-curved pair of forceps. The instrument being guided by ıger, it is scarcely more difficult to practise avulsion by this n through the anterior nares. In some cases the seizure of is facilitated, by pushing the polypus back with the finger, nto the anterior nares.

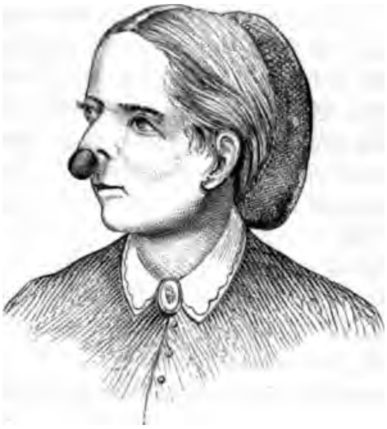
Membranous Polypi are generally multiple. I have ıy as fifteen or twenty in one nostril, growing from various mucous membrane, varying in size from a pea to a filbert. form in the submucous connective tissue, displacing the ıbrane, which constitutes their only investment. They must forceps and torn away one after the other; but in what- r and however thoroughly removed, they are exceedingly produced.

removal of either a soft or a cystic polypus, it is well to ctions, or insufflations of astringents for several weeks, to ir recurrence. Alum-water is perhaps as efficient in this y other agent, but it is not always successful.

Polypus. Syn., Polypus Nasi Fibrosus, R. C.; Fleshy; ıs.—These tumors have nothing in common with a true ept that they occur within the nares. They grow from the periosteum of any portion of the nose or adjacent cavities, he same character as those which proceed from the submu- tive tissue of the uterus. They are highly vascular, much a true polypus, of a reddish color, growing more rapidly a greater size. They soon fill the entire nasal cavity, and ause absorption of the surrounding walls by their pressure. r progress the patient is constantly liable to profuse nasal s.

Occasionally, I have found these tumors spontaneously strangulated in consequence of the pressure of the surrounding parietes, but their growth has been speedily renewed. Nothing but complete extirpation will suffice; and for this purpose a ligature of wire may be applied by the aid of a double canula, in the manner already described when treating of soft polypi, the ligature being retained until sloughing has taken place. I have once succeeded by this method in the case of a lad, sixteen years of age, but not until we had made one unsuccessful trial several months previous. The first tumor was larger than a hen's egg, and when the ligature separated, the whole mass fell into the pharynx, and it was swallowed. Warned by this experience, when the tumor returned, and had attained again about the same size, the ligature was applied as before, and on the third day the entire mass was removed by curved forceps through the posterior nares. The cure was this time complete.

Fig. 322.



Fibrous Polypus of the Nose.

We sometimes find it necessary to expose the tumor at the point of its origin, whether that be within the nose, or the antrum, or elsewhere, and remove it through the external opening thus made.

Encephaloid Polypi.—The limitations of fibroid and encephaloid nasal tumors, are not always clearly defined. They resemble each other in the points of their origin, in their progress, and in their external appearance; the essential differences to be noted being the greater rapidity of growth in the case of encephaloid, the more rapid disappearance of the adjacent bony structures, their greater tendency to bleed, and the early appearance of a constitutional cachexia. Indeed, there is reason to believe that the originally fibrous and relatively innocent tumor often becomes, in its progress, encephaloid and malignant.

It is not probable that any surgical operation will prove more than a palliative in these cases. If removed, the operation must be made through external incisions. A frightful hæmorrhage sometimes accompanies these operations, which, however, ceases ordinarily the moment the entire mass is removed. In case it persists to an alarming extent, plugs must be introduced into the posterior and anterior nares. Occasionally, before entering upon these operations, I have tied the common carotid on the corresponding side, and with considerable advantage, so far as the loss of blood is concerned.

Epistaxis, R. C.

The mucous membrane of the nose is thick, pulpy, and highly vascular, the vessels being supported by tissues which readily give way under moderate pressure; consequently nasal hæmorrhages are exceedingly frequent, and, unlike other hæmorrhages, seldom cause alarm.

The immediate causes of a nasal hæmorrhage may be stated to be—first, lesion of tissue, occasioned by ulceration, or lesion caused by external violence directly or indirectly applied; second, congestion of the vessels, this hyperæmia in some cases being permanent, and constituting a truly varicose or aneurismal condition; third, degeneration of the vascular tunics.

Epistaxis of the first class, which might be named traumatic, exists independently of any remote or constitutional cause, and generally ceases spontaneously.

Epistaxis due to congestion or hyperæmia, occurs under two very opposite conditions of the system, one of which is usually denominated "plethora," and the other "anæmia." In this regard, however, the mucous membrane of the nose is not exceptional, since all other tissues and organs of the body are liable to hyperæmia under the same opposite general conditions. The pituitary membrane is only singular in the small resistance which the walls of its vessels present under the pressure of congestion. Of these two remote causes, anæmia performs the most important rôle in the production of epistaxis; colorless children and chlorotic females presenting the most frequent and familiar examples. It is possible that other causes may co-operate with this condition of anæmia in producing congestions and hæmorrhages; such as obstructions occasioned by disease of various internal organs. No doubt such complications often coexist with anæmia, but whether in the relation of cause or effect, it might be difficult to determine. Paralysis of the vasa motor nerves, in consequence of the impoverished state of the blood, appears, however, fully adequate to explain the vascular congestions. Hæmorrhages of this latter class may cease spontaneously when the hyperæmia is relieved by the flow; but it is certain to return unless proper measures are taken to improve the condition of the blood and of the general system.

Hæmorrhages of the third class belong to advanced life. They are rare, but much more serious in their results than either of the other forms of nasal hæmorrhage, since at this period of life the processes of nutrition are slow, and the loss occasioned by a profuse bleeding is not easily repaired.

Treatment of Epistaxis.—The proper constitutional treatment can only be determined after an investigation of its remote or predisposing cause. The local treatment alone, demands in this place especial attention; and this will be nearly the same for all varieties of nasal hæmorrhages.

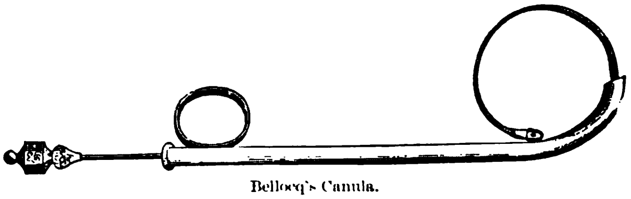
The head must be kept elevated and cool; while the feet and hands are made warm by plunging them in hot water. Everything must be removed from the neck calculated to prevent the free return of the blood through the large but superficial cervical veins; even a shirt-collar must be unbuttoned and thrown open. In order to keep the head cool, cloths moistened with cool water may be sufficient, but over the nose it is well to apply ice-water. Insufflation of cold water, or of water medicated with astringents, seldom succeeds; nor does it serve any better purpose when applied by means of a douche. The first object is to secure the formation of a clot, and this cannot be accomplished while water is thus employed.

The application of solutions of nitrate of silver can only be made safely with a camel's-hair pencil, and we seldom know, even approximately, the exact point of lesion. The persulphate of iron I have seen injected, but it has sometimes caused intense inflammation and swelling, which has extended even to the fauces and larynx, endangering life more seriously than the hæmorrhage. Nor has it even then generally controlled the bleeding. Of the two I would much prefer a trial of the ordinary astringents, by the aid of the douche, such as a solution of alum and water.

The truth is, after all, that it is better always to depend upon the plug formed by the clot; and, if the simple measures first suggested do not succeed and the hæmorrhage is alarming, it is best to resort at once to the tampon, by which this result is almost always promptly secured. It is very trying to be obliged to do this when the nose, mouth, and throat are inflamed and swollen by caustic applications; and nothing is more easy than to plug the nostrils before this has occurred.

In order to carry the plug into the posterior nares it is convenient to have a Bellocq's canula, but this instrument is by no means indispensable. An ordinary flexible bougie or catheter I have used much oftener than Bellocq's ingenious instrument. A piece of sheet-lint is folded into a pledget of about two inches in length by half an inch in thickness, —for the adult—and across its middle a strong linen or silk cord is tied, leaving the two ends of the cord free. A second cord is thus made fast to the pledget, leaving only one end free.

Fig. 824.



Bellocq's Canula.

The flexible catheter is now passed along the floor of the nares to the pharynx, where it is seized by forceps, or by the finger, and drawn out of the mouth; the free ends of the first cord are made fast to its extremity, and the catheter is immediately withdrawn, the tampon brought firmly to its place in the posterior nares, and the extremities of the cord tied over a second roll of lint placed against the anterior nares. In drawing the tampon to its place, it is well to guide it past the velum with the index finger. The second cord, still hanging from the mouth, is finally laid over the cheek and secured by a strip of adhesive plaster.

It is not advisable in most cases to remove the tampon earlier than the third day; at which time the anterior or nasal cords may be cut, and while the buccal cord is held in one hand, the index finger of the other will press upon it behind the velum and force out the plug. The importance of the buccal cord will now be recognized, since it not only provides against the danger that the plug may suddenly fall into the pharynx and be swallowed during the removal, but it facilitates greatly its dislodgment.

Rhinoplasty.

The operations for the repair or for the reconstruction of the nose, are to be varied according to the exigencies of each case; and it will only be possible to indicate a certain number of the leading methods.

In general it may be said that the various methods are all comprised under three classes, torsion, sliding, and transplantation from remote parts. Thus, for example, the nose may be repaired by integument borrowed from the forehead, this method involving torsion of the pedicle; by integument obtained from the cheeks, in this case the transfer being accomplished generally by sliding; and by integument taken from the arm, forearm, or hand, or by transplantation from remote parts.

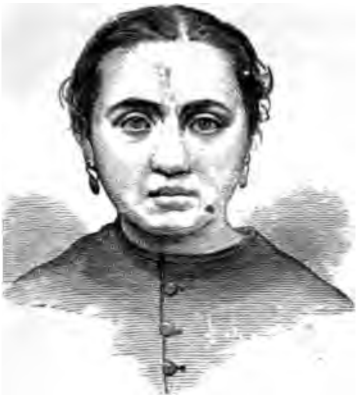
Having myself practised all of these three methods in the repair of the nose, I am prepared to declare my decided preference, in nearly all cases, for the first, or the operation by torsion, from the forehead.

Rhinoplasty by Torsion, from the Forehead. Kooma, or Indian Method.—In case the entire nose, including the nasal bones, is destroyed, having first assured ourselves that the patient is suffering under no serious local or constitutional malady or dyscrasy, the following rules and methods of practice are recommended.

First operation; for the closure of the nasal chasm.—Hitherto this operation—which I regard as preliminary and as essential to success in the class of cases now under consideration—has not been thought necessary, but the transplanted integument designed to form the new nose has been laid over the chasm, and attached only to its margins, or to the integument but little removed from the margins, consequently the centre of the flap has had no support, and was liable to fall through when the opening was very large, or at least to become very much flattened.

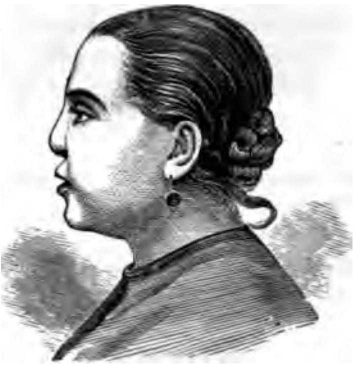
The opening, if small, may be closed by freshening the margins, and, after lifting the adjacent integument by subcutaneous dissection, slidnsate for subsequent contraction. The knife should cut firmly to the ne, including in the flap everything but the periosteum. On the ght side the incision may terminate opposite the inner canthus, but on e left it must be continued into the line of incision already made along e corresponding side of the nose. The pedicle should be broad, in-luding not only the smooth space between the brows, but, in some cases, portion of the brows themselves. 5. The flap having been elevated, turned toward the right hand of the operator, brought down and ecured in position by a number of fine silk sutures. There must be o strain upon the pedicle, or upon any portion of the flap. 6. Strips f sheet lint covered with cerate are laid over the nose, and the whole overed with a mass of cotton batting, retained by a light turn of a roller. The wound in the forehead may be left open, covered only with cerate, r it may be closed in part by adhesive plasters.

Fig. 326.



Photograph of M. C., Front View. Operation by the Author.

Fig. 327.



Side View.

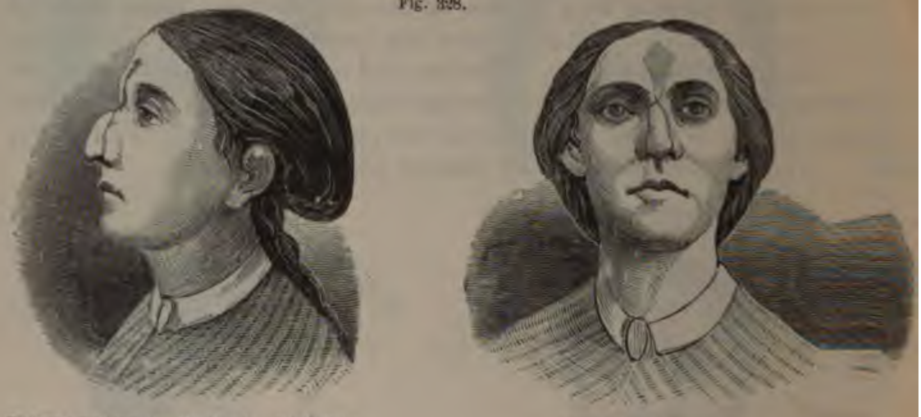
It will be observed now that the flap is so large that it lies in folds. t this excess of size is necessary in order that it may be free to ntract and thicken, since it is upon this alone that I rely to give evation to the nose. Most operators have preferred to keep the flap evated by supports until cicatrization is completed, and as a conse-ience the integument has not been allowed to thicken, and when the pport was removed the flap has fallen. They have had in view, more-er, the re-establishment or preservation of the nasal apertures, which d cannot always be attained by my operation, but which is really a atter of small moment.

It may be necessary to remove an apprehension that the under surface the flap may not unite with the outer and tegumentary surface of e nose. Repeated observations have shown that it will unite, and at in any part of the body a raw flap pressed close upon a tegumen-ry surface will, in most cases, unite in a similar manner.

The columna should be made from the forehead, even when it is necessary to include a portion of the hairy scalp. If hair grows again after transplantation, it will be found to be small, the follicles having degenerated in consequence of lack of nourishment.

Finally, it will be left to the judgment of the surgeon to determine, after the lapse of four or six weeks, whether it will be advisable to cut and unroll the pedicle, and replace a portion of it in the space between and above the eyebrows.

Fig. 328.

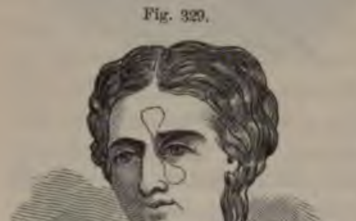


Rhinoplasty from the Forehead. First Step. By the Author.

Front View of same.

In the same manner I have repeatedly closed an opening on the side of the nose, or supplied the loss of a portion of the end of the nose after the removal of an epithelioma.[1] In such cases, however, the pedicle is always cut at the end of three or four weeks, and replaced in the forehead. In the accompanying wood-cuts (fig. 326) is represented the case of a woman, the end of whose nose was bitten off in a brawl, January 1st, 1867.[2] I operated on the seventh day after the injury. One month later she was placed under the influence of chloroform, for the purpose of having the pedicle divided and replaced, but before I was ready to operate she ceased to breathe, being killed by the anæsthetic. The wood-cuts represent, therefore, the condition of the patient immediately prior to the separation and replacement of the pedicle, which would have completed the operation.

Fig. 329.



Result of Operation. By the Author.

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[1] *Rhinoplasty*, a paper read before the New York Academy of Medicine, February, 1869, and published in the "Bulletin."

[2] *The Med. Rec.*, New York, May 18, 1867.

Fig. 329 represents a case in which an epithelioma was removed by ie author from the side of the nose, the wound being repaired by in- gument transplanted from the forehead. The dotted lines indicate ie original incisions. One year after the operation, when this photo- aph was taken, the cicatricial lines indicating the course of the inci- ons were nearly obliterated.

Rhinoplasty by Sliding, generally called the **French Method.**— the loss of integument is very limited, this method is sometimes racticable; but the tension of the flap necessarily resulting from the retching of the skin in the process of sliding, is apt to draw the nose entually to one side. In other cases the union fails wholly, and the ip retreats to its original position. We have usually avoided these cidents in a measure, however, by supporting the integument of the ce by adhesive plasters, and by cutting the flap at its base at the id of twelve or fourteen days, when union at the opposite margin was mplete.

In some cases integument may be taken from the cheek and removed the nose by torsion, the pedicle being subsequently cut and replaced, not, as may be found necessary.

Rhinoplasty by Transplantation from Remote Parts. Ital- n Method.—The usual mode of procedure by the Italian method is borrow integument from the arm or forearm; the arm being first cured in position by a properly constructed apparatus, or by bandages. The vestige of nose having been freshened, the flap is lifted from the m, and made fast to the face by sutures. On the fifth or sixth day, as soon as union is established, the pedicle is severed, the arm releas- l, and the adjustment of the flap completed.

The position of the arm demanded by the Italian method has always en found fatiguing to the patient, and in some cases it has proven so tremely painful that surgeons do not often at the present day resort it. Dr. Prince, of Illinois, has contrived a very ingenious apparatus a substitute for that used by Warren and Tagliacotius, the framework which is composed of iron.[1]

The following case will illustrate an original method of rhinoplasty om the hand. Dieffenbach, in his Operative Surgery, published in 856, says that Labat had formed a columna nasi, by a flap taken from ie palm between the thumb and the index finger; but I am not aware iat any other surgeon than myself has attempted to form any consid- rable portion of the nose from the hand.

When a child, the patient had lost a large portion of his nose from a urn. The face was also extensively scarred, the mouth contracted, id the left upper and lower eyelids were everted. March, 1847, I perated for the restoration of the upper and lower lids, and a few days ter I enlarged the commissures of the mouth. March, 1848, the first operations having proved successful, the right ala of the nose was restored by a sliding operation. There was then no remaining integument upon the face or forehead sufficiently free from cicatrices to be used for the restoration of the opposite ala. March 29, the operation for reformation of the left ala and the end of the nose was commenced. A flap was dissected from the ball of the thumb of the right hand, two inches in length by one and a half in breadth, its base resting over the radial border of the metacarpal bone of the index finger; it was then turned back, dressed with simple cerate, and enveloped in cotton batting. At the end of two weeks the flap, by sloughing and contraction, had diminished to about half its original size, but it was three times its original thickness. April 12, having placed upon the head of the patient a cap furnished with straps, the nose and the margins of the flap were freshened, and by means of a sling the arm and hand were brought up and secured to the cap, the flap being made fast by five small sutures. A pillow was slung under the arm-pit, against which the arm rested. Two students were left in attendance to assist the patient in supporting the arm, and these were relieved every four hours by others. Precisely at the expiration of seventy-two hours, the integument was severed and the hand released, the patient being already much exhausted, and impatient for the separation to be effected. A small portion of the flap sloughed after the separation, but enough remained to give a satisfactory result.[1]

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[1] *Plastics*, by David Prince, M.D., Lindsay and Blakiston, Philadelphia, 1868.

Tagliacotius, in transplanting from the arm, always left the flap to contract and cicatrize several days or weeks before making it fast to the face. Modern operators have, in most cases, applied the flap at once, but it is doubtful whether by this procedure the operation has been improved. The vascularity of the integument covering the arm and hand is very much less than that of the face, and flaps lifted from the former are for this reason much more liable to slough than flaps, of equal size and form, taken from the latter. By lifting the integument from the arm or hand, and permitting it to inflame and thicken before it is attached to the face, the danger of a failure to unite and of sloughing is probably materially lessened.

In case the *columna* alone is destroyed, it is best replaced by intercepting a portion of the upper lip by two parallel vertical incisions, and then lifting and attaching the intercepted piece to the apex of the nose; closing at once the wound in the lip by sutures. The mucous membrane which is exposed eventually assumes very much the appearance of integument.

When the bridge of the nose is greatly depressed, without loss or deformity of the end, the only proper remedy is transplantation from the forehead; a piece of integument being laid over the depressed portion like a saddle.

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[1] *Buffalo Med. and Surg. Jour.*, vol. iv., p. 459, Jan., 1849

But in those cases in which the falling of the bridge has tipped the end of the nose upwards, it will be necessary to dissect the integument from above downwards, and slide the end of the nose and its alæ downwards, and then immediately supply the loss of integument above by transplantation from the forehead; or, where the amount of integument to be supplied is very small, by sliding integument from the opposite sides of the nose.

Finally, we wish to correct an error into which all young surgeons must inevitably fall if they have never seen the results of rhinoplasty, when made for the restoration of a nose which was completely lost, but who have obtained their information only from the illustrations in the various surgical treatises. A well-proportioned, perfect nose was probably never made in such a case. Indeed, if the nose is inspected one year after the operation is completed, it will, in most cases, be found to be little else than a flabby, fungous-looking appendage, whose cosmetic value would be very doubtful, were it not that it closes in from view those hideous nasal caverns.

When only a portion of the nose has been destroyed, and especially when the support of the nasal bones and of the septum is preserved, very much better results may sometimes be attained. Not to speak of what we have ourselves been able to accomplish in some of these cases, we may be permitted to call attention to a nose constructed by Dr. Krackowizer, of this city, and worn by a fellow-citizen, as one which is perfect, inasmuch as no one could say, from inspection, that it was not the original organ.

CHAPTER V.

SURGERY OF THE LIPS AND PALATE.

Hare-lip. Syn., Labium Leporinum. Labrum Leporinum, R. C.

Hare-lip is a congenital malformation, and a result of arrest of development. The upper lip is formed from three points, namely, a central and two lateral points, and, whenever the union of these several portions is not completed, a fissure results. The fissure is, therefore, very seldom, properly speaking, central, but it is upon one or both sides. Warren, in his "Surgical Cases," has, however, reported one example of true central fissure, the line of separation passing between the first incisors.

It is convenient to divide hare-lip into two principal varieties, namely, single and double, according as it is found to exist upon one or both sides. Either of these varieties may be complicated with a fissure of the alveolar arcade of the hard and soft palates. Fissures in the alveolar arcade are, like fissures of the lip, the results of arrest of development; the maxillary bones not having become united with the incisive or inter-maxillary bones. Indeed, this condition of abnormity in the human species corresponds to what is observed to be normal in certain of the lower classes of vertebrata; the central, intercepted promontory of bone answering to the premaxillary bones of these animals.

Period most favorable for the operation.—There can be no doubt that, if we regard the danger to life from the operation alone, it is increased in a tolerably exact ratio as we approach the period of birth; but, on the other hand, the danger to life from inability to receive food, while the fissure of the lip remains, is, in very many cases, quite equal to the hazards of the operation. In addition it may be said, that an early operation is more certain to leave a perfect result in later life; and it is believed that in case the alveolar or palatine bones are separated, also, the pressure of the reunited lip will aid in their approximation.

In a great many cases, both in this country and elsewhere, the operation has been made on the first day after birth; and Dr. Raborg, of this city, informs me, that, having operated upon the first day, the child was able to nurse on the fourth. Perhaps the majority of experienced surgeons have preferred to operate between the sixth and sixteenth week. The earliest period at which I have myself operated is the seventh day.

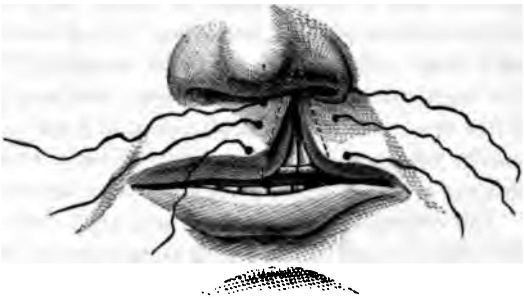
There is another question, of even more importance than that which relates to the age of the patient, namely, the condition of health. The testimony of experience is upon this point conclusive. If the child is exceedingly delicate or feeble, if it has a diarrhœa, or an eruptive affection, or any other disturbing malady, it is better to wait. Nor ought the operation ever to be made during the period of first dentition.

Moreover the season of the year, as an active predisposing cause of disease in early life, is always to be considered. In consequence of the operation, and perhaps partly in consequence of the reception of blood into the stomach, infants generally suffer from diarrhœa on the second or third day, and, if the operation is made in midsummer, these intestinal disturbances sometimes prove fatal.

In regard to the use of anæsthetics, it may be remarked that infants pass under their influence very quickly and pleasantly, and there is perhaps no instance of death from this cause; but feeble infants often look very much prostrated after their employment, and I believe they are rendered more liable to the occurrence of diarrhœa. On the whole, as the operation usually occupies but a few moments, it might be as well to omit them generally.

Single Uncomplicated Fissure.—The instruments required for this operation are a pair of forceps, a strong pair of scissors, and a knife. In order to secure the hands of the child it is only necessary to withdraw the arms from he sleeves of the dress and place them inside of he waist.

Fig. 330.



Operation as practised by the Author in Uncomplicated, Single Fissure.

The child being held upon the lap of an asistant, the surgeon eizes the lip with his ingers, and with a few ncisions separates it rom the alveoli; then, with the strong scissors, he cuts away both free margins, taking care that sufficient is removed, so that a broad and traight raw surface shall be exposed. While these incisions are making, and until the fissure is closed by the sutures, an assistant should hold upon the lip on either side to control the coronary arteries.

The moment the incisions are completed the surgeon plunges a large, straight needle, armed with a heavy silk thread, through the lower margin of the lip, about three lines from the cut surface, and half a line above the junction of the integument with the vermilion border, and brings out the needle upon the opposite side at a corresponding point. A second needle, having a straight shaft but curved point, furnished with a similar suture, is then introduced near the upper margin of the fissure and equally remote from the cut surface. In the case of infants, and especially when the fissure does not extend fairly into the nostril, wo sutures are sufficient. In other cases a third must be introduced at an intermediate point. The sutures are now tied, commencing with he uppermost. If the lower suture is tied first it is apt to slide over the vermilion border and fold it in. The bleeding ceases at once when the sutures are tied. The dressing is completed by adhesive strips laid over the lip from one cheek to the other.

Some words of explanation, and perhaps of defence, of this mode of operating, may be necessary. All my operations for hare-lip have been carefully recorded, and by one of my pupils they have been classified and analyzed.[1] Up to Jan. 1, 1872, they amount to fifty-five cases; and of these three only have failed to unite. One of the failures was my first operation, in which case I employed hare-lip pins, and never saw the patient after the operation was made. In the second case, also, he patient was operated upon at a dispensary, and the mother did not eturn to me until the end of the week, when I found the adhesive lasters loose, and the lip, which had evidently united, torn out. The third case united, but the child was exceedingly feeble, and on the fifth day the union gave way, and on the ninth day she died. My contemporaries have not furnished any exact statements of their results, but when I was a young man, M. Roux used to say that we were not to expect more than two successes out of every three cases. Roux operated with pins, as, indeed, most surgeons have done since they were first introduced by Ambrose Paré; yet, as I think, with no good reason. After my first unfortunate operation I have never used them, and the results of my operations ought to be a sufficient defence of the silk sutures, which I have, since that time, universally employed.

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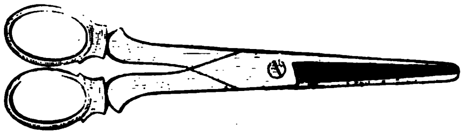
[1] *The Medical Record*, New York, June 1, 1867.

The objections to the pins are, that they do not transfix the entire thickness of the lip, and that consequently the posterior margin of the fissure is not held well in contact; they leave projecting ends which are constantly liable to be hit; they are in the way of a neat and proper adjustment of adhesive plasters.

The metallic suture presents also some obstacle to the use of adhesive plasters; they are not so easily removed, and they are quite as likely as the silk sutures to cause ulceration. Perhaps, if the sutures were permitted to remain many days, a difference in this regard might be observed, and the metallic sutures might offer some advantages; but they possess no advantage in cases of hare-lip when the sutures are removed as early as the third, fourth, or fifth days.

A strong, unyielding, clean-cutting pair of scissors, such as I have had constructed expressly for this purpose, removes the margins of the fissure more quickly and more satisfactorily than the knife. And I have found a straight incision better in most cases than any of the various modifications hitherto suggested; but, if one desires to give to the incision any special form or direction, it can be as easily accomplished with the scissors as with the knife.

Fig. 331.*



Hare-lip Scissors.

Finally, upon the proper application of the adhesive strips much of the success of the operation is to depend. Their purpose is threefold: first, to draw the cheeks so firmly together as to remove all strain from the sutures; second, to compress and flatten the margins of the wound, operating in this respect very much as Dr. Bozeman's button is known to do in securing accurate apposition of vesico-vaginal fistulæ; third —by permitting the lower strap to completely overhang the lower margin of the lip—to protect the lip from the spoon when receiving food, and to prevent it from becoming dry. If the prolabium is constantly exposed and not subjected to the moderate pressure of the strips of plaster, it is apt to swell and crack open.

The plaster strips, in order to be efficient, need to be renewed, after the second day, every twenty-four hours: the cheeks being supported by an assistant while the surgeon cuts them in the centre—removing those portions only which have become moistened, and leaving the portions covering the cheeks. With warm water and soap, and a soft sponge the lip is made clean, and the wounds caused by the sutures examined. If any degree of ulceration is observed, a solution of sulphate of zinc, of the strength of one or two grains to the ounce, must be applied with a camel's-hair pencil. Usually it will be safe to remove one of the sutures as early as the third or fourth day, and rarely need any of them be left after the fifth, but the straps should be continued from seven to fourteen days.

Hainsby's spring cheek compressor appears to me a very awkward substitute for adhesive strips, and it is seldom used by surgeons in this country, although Mr. Fergusson thinks it of great value as a support to the lip, and in some cases of wide fissure he has used it with advantage for some time previous to the operation.

In one case of single fissure which was only about one-half an inch in depth, the following expedient secured an admirable result. The lip was transfixed with a narrow bistoury above the apex of the fissure, and from thence the incision was carried downwards and outwards to within a few lines of the border of the lip; from the same point of beginning the knife was carried downwards and inwards, and the intermediate loop of integument displaced downwards; after which the triangular hole in the lip was closed by a couple of sutures. At first the loop formed a projection upon the border of the lip, but in a short time it contracted and the line of the lip was left remarkably perfect.

The same procedure may be adopted in cases in which a slight failure in a previous operation has left a depression in the border of the lip.

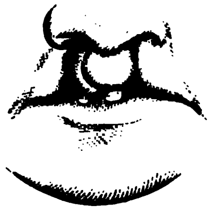
Single Fissure; complicated with Fissure of the Alveolus, or with Fissure of the Alveolus and Palate Bones.—The fissure in the alveolar arcade corresponds uniformly to the space between the second incisor and the cuspid, indicating the line of original separation between the maxillary and intermaxillary portions of the upper jaw.

In these examples the maxillary bone on this side is usually depressed, and the ala of the same side is both depressed and displaced laterally. The outer margin of the labial fissure is much obliqued outwards, and bound to the gums by a membranous frænum. The central or intermaxillary portion of the jaw contains usually the germs of two teeth, one of which generally presents toward the fissure.

The operation for the relief of this deformity is the same as that for single, uncomplicated fissure, with these exceptions. The germ of the second incisor, if presenting toward the fissure, ought first to be removed, by a pretty deep circular incision with the point of a strong knife; the membranous frænum beneath the outer margin of the fissure must be cut freely, and the dissection must be continued well up under the outer ala in order that it may be lifted, and that it may be drawn, without strain upon the suture, toward the septum. The knife should be kept close to the bone, to avoid wounding large vessels. The frænum which underlies the internal margin of the fissure should not be divided so freely, inasmuch as it is not desirable that this portion of the lip should be much displaced by the traction of the sutures, but rather that it should remain as a fixed point. It must be divided, however, sufficiently to allow one blade of the scissors to pass underneath; and at the same moment any portion of the gum which lies exposed may be shaved off, so as to give a broader surface for adhesion. In removing the very oblique outer margin of the fissure, care must be taken that the incision is sufficiently prolonged both above and below; and all the curve, which some surgeons have considered desirable, can be given to the incision, by seizing this margin with a pair of toothed forceps midway between its upper and lower extremity, and cutting with the scissors while traction is made with the forceps. Finally, these examples generally require three sutures, the uppermost of which must be entered at the outer margin of one ala, and brought out near the outer margin of the opposite, crossing the median line just below the columna nasi. I have sometimes added a fourth, on the lower or lower and inner margin of the prolabium, made with a delicate silk thread. Several surgeons of much experience think this suture ought never to be omitted; but I have observed that it is apt to be disturbed in feeding, and that it is very prone to cause ulceration. I therefore use it only exceptionally, and always remove it as early as the second day.

Double Fissure, complicated with Fissure of the Alveolar Arcade.—I have not met with any examples of double fissure which were not complicated with fissure of the bone; but in other respects these cases present a considerable variety of conditions.

Fig. 332.



Double Fissure, complicated with Fissure of the Alveolus.

The central or intercepted bone always contains the germs of the four incisor teeth. In one example I found it to contain the germs of six teeth. At least two of these teeth, or their germs, usually present obliquely outwards; sometimes directly forwards. It is situated more or less in advance of the lateral portions of the superior maxilla; sometimes very slightly, and at other times the vomer carries the central piece forward in such a manner that the intermediate tegumentary covering is on the same line and continuous with the ridge of the nose.

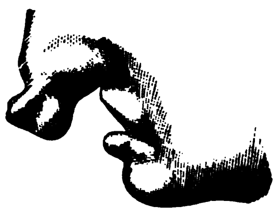
The treatment of a case of this kind, in which the central portion projects only moderately, presents no special complications. No one thinks now, I trust, of operating upon the two fissures at different periods of time, as was once proposed, and perhaps practised.

Both tegumentary fissures are to be treated in the manner already described, the central piece of integument being reduced to the form of the letter V. The sutures are then passed from side to side, underneath the central piece, and tied over the median line. To obviate all danger of ulceration or strangulation of this tongue of integument, it will be prudent to interpose a narrow fold of sheet-lint between it and the knot.

The surgeon must not forget to remove the germs of those teeth which present directly forwards or toward the fissure. These teeth develop usually very rapidly, and we have seen them break up an adhesion, which was already completed, by the projections which they caused.

When the inter-maxillary bones project very much they must either be cut away or displaced. If on examination it is obvious that the inter-maxillary prominence is too much elevated, as, for example, when it is nearly or quite on a level with the ridge of the nose, the tegumentary covering must be lifted by dissection, and the bone cut away with cutting forceps or scissors. The artery of the septum usually bleeds very freely on making the section of the bone, but pressure with the end of the finger, continued a few minutes, will generally control it. The lip is then to be closed in the usual way; the piece of integument attached to the end of the nose being left hanging, for the purpose of making use of it, one or two months later, to form a columna. If this is not done, the interior nares present a very open and unsightly appearance. When the bony promontory is less elevated, but so much above the line of the maxillary bones as to occasion serious deformity, it may be bent or crushed into position.

Fig. 333.



Double Fissure, with projecting central piece.

Notwithstanding I never have occasion to use hare-lip pins in this operation, it seems necessary, since so many of my contemporaries continue to employ them, to describe their mode of application.

Soft iron wire is now generally preferred to the inflexible silver pins, one extremity being furnished with a steel point. Two of these are generally employed, each pin being introduced about one-quarter of an inch from the margin of the fissure, and, after penetrating two-thirds of he thickness of the lip, it is carried across and brought out in the same manner upon the opposite side. A piece of silk thread, or of some more oft material, such as white yarn or candle-wicking, is then carried around the lower pin and across the fissure, in the form of the figure 8, or in the manner that children wind their kite-strings. Dr. Gross prefers to wind the thread around the pins without crossing—that is, in a circular or elliptical manner. In the same manner the upper pin is enclosed with a separate thread. After which, by similar diagonal turns, a third suture is made to unite the two pins, and to compress in some measure the intermediate portion of the lip. Lately we have observed that many surgeons, who employ the pins, add also the adhesive plaster; yet it is apparent that, over the irregular projections caused by the threads and pins, they are used to less advantage. Finally, the points of the needles are removed, and the dressing is complete. The practice is usually to remove the pins on the third or fourth day, and thereafter to rely upon the adhesive plasters alone.

Congenital Fissures of the Lower Lip, and of the Commissures.—A cleft of the lower lip has been seen occasionally as a congenital deformity; and more frequently there has been observed an extension of one of the commissures, the teeth upon one side being exposed to view as far back as the last molars; or there may exist an elliptical opening through the sides of the cheek.

These malformations, like hare-lip, are examples of arrest of development. The treatment—by plastic surgery—is very simple, and in most cases successful. It will not be necessary to describe the various operative procedures demanded in these cases.

M. Dumarquay has lately called the attention of the Surgical Society of Paris to a little girl with double hare-lip, in whose family there have been eleven cases of deformity of the lip, passing through three successive generations; but in several of these cases the congenital deficiency consisted in two openings in the lower lip, "on either side of the mesial line, penetrating the whole labial thickness, with a peculiar form of the lip itself." He mentions, also, that he had first called attention to a similar malformation, in the *Gazette Médicale*, so early as 1845.

Cleft Palate. Syn., Fissura Palati, R. C.

Coexisting with fissure of the lip, as has already been observed, there is not unfrequently fissure of the palate; but such fissures may exist independently of hare-lip. The uvula alone may be cleft; the cleft may involve both the uvula and the velum, or it may extend more or less forward through the hard palate; finally, the arrest of development is, in rare cases, limited to the bony structures of the palate, with or without fissure of the lip.

M. Roux, in 1819, made the first successful operation for cleft palate; since which time surgeons have introduced various improvements and modifications, and its application has been gradually extended, from the closure of a simple fissure of the soft palate, to the occlusion of the most extensive fissures of both the soft and hard palate. Among those who have especially contributed to the perfection of this operation the names of the two Warrens, Fergusson, Pollock, Langenbeck, Mettauer, Mütter, Pancoast and Dieffenbach are most distinguished.

The term "staphyloraphy," originally employed to designate closure of any portion of the palate, is now limited to the operation upon the soft palate; while the term "uranoplasty" is applied to the operation upon the hard palate.

Staphyloraphy.—Until recently no attempts have been made to operate during the period of infancy or early childhood, it being considered necessary that the subject of the operation should have arrived at such years of discretion as would enable him to control, in some measure, the motions of the mouth, throat, velum, and the various other parts concerned. Nor is it yet rendered certain that the advantages of an early operation are commensurate with the difficulties and embarrassments which, notwithstanding the admitted improvements, the surgeon must still encounter at this period of life. Mr. Fergusson, whom I am disposed to regard as a very trustworthy authority upon this subject, never attempted the operation in infancy, and considers the chances of success best at or beyond the period of puberty. He succeeded, however, in children between the 10th and 15th years of life. I have once made the operation in a child twelve years of age, but it proved a failure: the failure, however, had nothing to do with the age of the patient, since she was able to control her mouth and tongue quite as completely as any adult upon whom I have operated.

The patient must be in perfect health, and the mouth must have the average capacity of expansion to insure success. It is well, also, to have him under observation for a week or two prior to the operation, in order that he may be trained, and that the parts may become accustomed to the touch and pressure of the surgeon's fingers and instruments.

The instruments required are, a pair of long, toothed forceps, a long, narrow-bladed, sharp-pointed knife, a pair of strong scissors curved upon the flat side, Warren's curved, spear-pointed knife, a periosteum elevator, short curved needles and a needle-holder. There will be needed also sponges and sponge-holders, and ice-water; the latter to control hæmorrhage. Well-waxed silk is the only ligature I have used in these cases, and probably no other will be found so manageable, or less liable to give way; especially since in this operation the parts are never allowed to be upon the strain.

I have in my possession a variety of other instruments which have been contrived for carrying the needle and for other purposes, such as the crochet-aiguille of Schwerdt, Warren's straight and recurved needles in fixed handles, Carr's staphyloraphy instrument, and the instrument of Depierris—the two latter operating upon the principle of the sewing machine—also Simpson's canulated needle for conveying wire ligatures. They are all ingenious, but some of them are complicated and liable to become disarranged, and none of them will so constantly meet the emergencies as the common curved needle, employed with a firm needle-holder. Nevertheless it may be prudent to have more or less of the instruments I have named at hand. Indeed there are many other instruments which may at times be found exceedingly useful, such, for example, as the chisel-shaped knife of Pollock, which can be adjusted to any angle with the shaft, and may thus be made to adapt itself to the greater or less curve of the vault; periosteum elevators of various sizes and forms; straight scissors, and scissors curved upon the narrow side; Warren's set of forceps; long, mouse-toothed forceps; Sim's adjuster, for wire sutures; tenacula, etc. And in case anæsthetics are used, a wire gag and tongue-holder, and an apparatus for conveying ice-water spray upon bleeding vessels.

The method which I shall describe is the same which was practised with so much success by John Mason Warren, and which I have myself adopted in the few operations I have hitherto made. It is indeed essentially the same as that practised by Fergusson, Pollock, and Langenbeck. Each of these gentlemen have introduced certain changes in the mode of procedure, but some of these changes involve no new principles, and others have not established by indubitable evidence their claims to preference.

First. In nearly all cases in which the fissure in the soft palate is complete it will be found impossible to close the cleft at its upper angle, without having previously loosened the attachments of the velum to the bony palate from which it is suspended. This is done by the curved, spear-pointed knife, or by Pollock's chisel-shaped, movable-bladed knife. Care must be taken not to extend the dissection to the spheno-palatine foramina, lest the superior palatine artery should be wounded. A wound of this artery in the operation of staphyloraphy does not endanger the integrity of the flaps, as in uranoplasty, but the bleeding may be troublesome and may require prolonged pressure with the finger for its arrest. There are several small vessels originating from the inferior palatine artery which are, however, necessarily wounded, and which bleed for a few moments somewhat freely.

Second. One moiety of the uvula being seized with the forceps and drawn forwards and across the fissure, two bands are thrown into relief, each terminating in the base of the uvula; one of these is the posterior pillar of the palate, and indicates the position of the palato-pharyngeus muscle; the other band is a little above and behind the posterior pillar, and indicates the course of the levator-palati. The palato-pharyngei, in the normal condition of the velum, when in action, approximate the posterior pillar, but, when the palate is cleft, their action separates the lateral halves. The palato-glossal, composing the anterior pillar, and the tensor palati, it is thought, act in a similar manner, but most operators have only found it necessary to divide the two first-named muscles in order to secure the requisite immobility to the palate and velum. Warren accomplished their section, while the uvula was held in the position already described, first, by a powerful stroke across the free margin of the posterior pillar with the curved scissors, extending the incisions forwards and backwards, so as to divide the mucous membrane until all ension was relieved. The second fold, consisting chiefly of the levator palati, with its mucous covering, was then divided in a similar manner.

Warren thus effectually divided those two muscles which most interere with the success of the operation, and in April, 1843, he published he results of fourteen operations made according to this method. In December, 1844, Fergusson read before the Royal Medical and Chirurical Society a paper, announcing a new method of operating, in which e divided the palato-pharyngeal muscle and the levator palati; the rst in precisely the same manner as Warren had already done, namely, with the scissors, and the second by passing the knife "through the fisure, so that its point can be laid on the tissues immediately above the oft velum, midway between its attachment to the bones and the poserior margin, and about half way between the velum and the lower nd of the Eustachian tube; the point is then thrust deep, and carried half an inch or more backwards and forwards, so as to cut the levator palati." He has not thought it useful, generally, to cut the palato-glosal or the tensor palati. Without intending to detract from the credit lue to Mr. Fergusson, it must appear, then, that to him we are indebted for indicating by name what muscles he divided, although Warren had, probably without being aware of the fact, preceded him in their diviion; and that he substituted subcutaneous section of the levator palati for Warren's simpler but perhaps equally effectual method. Warren leclares that in his operations the uvula was put at rest; and Fergusson ays that he has found it, "in some instances, difficult to arrest all muscular movement" by the method which he substituted for Warren's.

Pollock divides both the levator and the tensor palati, by thrusting a knife through the soft palate, on the inner side of the hamular process, above the line of these muscles, and then, depressing the point of the knife freely, making a sweeping cut through the posterior surface of the palate. He does not find it necessary to divide the palato-pharyngeus or palato-glossus. In Mr. Fergusson's last communication upon this subject, I find that he considers a division of the levator palati alone sufficient.

It is by no means determined, then, which of the three muscles it is most necessary to divide, nor in what precise manner the division can be most conveniently practised; but, since all claim to have attained the same result, namely, paralysis of the uvula and velum, we venture to submit whether the question of the exact mode of procedure is not still open; and to suggest, that it is by no means determined whether any of hese excellent English surgeons have made any improvement upon the operation as practised by Warren.

Third. The margin of the fissure is seized below its middle, and, with a sharp-pointed knife, a narrow ribbon is removed from one side and then from the opposite. If the uvula is long, a portion of it may be excised.

Fourth. As soon as all bleeding has ceased the sutures are introduced —the middle first and the lower last. The edges of the fissure must, of course, be brought into contact, but there must be no strain upon the sutures, nor must they be tied so tightly as to strangulate the intermediate tissues.

A very ingenious mode of passing the sutures has been devised by Mr. Avery, by which each suture may be introduced from the anterior surface of the velum. A straight or slightly curved needle, attached to a handle, and armed with a fine suture, is thrust through the velum, when the suture is seized behind the velum and drawn through double, the needle being at the same time withdrawn. A second and stronger suture is then passed through the opposite side of the cleft in the same manner, one end of which is seized and brought out of the mouth, while the needle is withdrawn. The second suture is now passed through the loop of the first, and, the first or double suture being pulled upon, the second is brought out.

After the operation, the patient must be fed upon animal broths, or such other forms of nutritious fluids as he may choose: of these he may partake freely. He should be advised not to converse, or to open his mouth widely. The stitches are not to be removed earlier than the seventh day, nor is it objectionable, in some cases, to leave them later.

Uranoplasty.—Warren preferred, in case he found it expedient to attempt the closure of the bony palate, to perform the operation at the same time that he closed the soft palate; and having, therefore, commenced the separation of the mucous membrane—including the submucous areolar tissue—from the posterior portion of the bony fissure, in the manner which has already been stated, it was continued forwards to the termination of the fissure in front, and laterally on each side toward the alveolar arcade, until the loosened membrane could be made to meet easily in the median line. Care was taken not to wound the palatine arteries. It was observed that in most of the cases there was no deficiency of materials to fill the gap; the great breadth of the fissure being usually a result of the oblique direction of the sides of the vault rather than of actual deficiency of bone; consequently, when the flaps were loosened, and allowed to fall into a more nearly horizontal position, their edges generally met, and there was no need of lateral incisions. The edges were then pared and closed by silk sutures.

Notwithstanding Dr. Warren thus succeeded in closing a very large proportion of the cases of fissure of the hard palate upon which he had operated, he ceased, in the later years of his life, to make the operation, except in cases where the fissure was narrow, having become satisfied that properly constructed obturators were suitable substitutes for a tedious and somewhat uncertain operation.

Lately, however, Langenbeck claims to have essentially modified and improved Warren's operation, by including in the flap not only the mucous membrane and the submucous areolar tissue, but also the periosteum. He terms his method "muco-periosteal uranoplasty."

There are three essential points upon which it is declared the success of Langenbeck's operation mainly depends: first, that by the aid of a somewhat blunt instrument, the periosteum be lifted with the mucous membrane; second, that the two spheno-palatine canals and the anterior palatine canal be avoided in the dissection, since a wound of the superior palatine artery is apt to lead to the destruction of more or less of the flaps; third, the formation of lateral incisions, to allow the flaps to slide inwards.

It will be observed, however, that Warren also sought to avoid lesion of the palatine artery, and that he omitted the lateral incisions only because he found they were not generally necessary. To Dieffenbach, and not to Langenbeck, we are indebted for the first suggestion of the lateral incisions; and, whatever advantage they may possess, the credit of their introduction does not, as is well known, belong to Langenbeck.

That which "especially distinguishes this method (of Langenbeck) is the inclusion of the periosteum within the flaps, with a view to the reproduction of bone."[1] Yet it does not appear that we have much testimony that a result so desirable as a reproduction of the bony vault has yet been attained. Of 55 cases collected and arranged by Whitehead, himself an ardent disciple of Langenbeck, in which this new method has been practised by Langenbeck, Simon, and others, only one is mentioned in which bone has been reproduced. Of this case it is said 'there was a good formation of bone." It would be instructive to know precisely how much is meant by this expression, and whether the examination of the vault has been made with sufficient care to preclude all sources of error.

The truth is, however, that neither Warren nor any one else has ever been able to raise the mucous membrane in these cases without lifting also the periosteum. The mucous membrane and the periosteum lining the roof of the mouth are too closely united to be separated, even in the dissecting-room, without the greatest care and painstaking; but to accomplish such a separation in the living subject with the instruments employed by Warren was simply impossible. Warren did indeed speak only of lifting the "mucous membrane," without referring to the areolar tissue and the periosteum, which must of necessity have been lifted with it; as one might speak of raising the dura mater, without referring in terms to the serous lining which would of necessity accompany it.

There is really no excuse for this misconception on the part of the German surgeon. He ought to have seen that Warren intended to include the periosteum when he spoke of the mucous membrane, and that he actually lifted both whenever he made the operation of uranoplasty. The real points of difference are as follows:—Langenbeck, adopting Dieffenbach's suggestion, has resorted to lateral incisions, which serve to relieve a little the tension of the flaps, and through which the operator will find it more convenient generally to lift the flaps from the bone; and he has employed the periosteal elevator where Warren employed the scissors and the blunt hook. In either way the periosteum can be easily raised, but by Langenbeck's method it is the most readily accomplished.

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[1] **Surgical Treatment of Cleft of the Hard Palate, with an Illustrative Case. By Wm. R. Whitehead, M.D., New York.** *New York Med. Jour.* **April, 1869.**

I wish to add that Mr. Fergusson has said, in one of his recent lectures, speaking of the separation of the soft tissues from the hard palate, and of Dr. Warren's claims, "I know of no originality before his, and that I look upon all modern claims to such originality as arising from ignorance or a desire to rob the fair reputation of a name which, in son as in father, will stand for generations among the brightest in surgery."[1]

Of Langenbeck's success in closing the fissure, without reference to the formation of bone, Whitehead informs us that, of twenty-one cases of congenital fissure operated upon by this surgeon, four resulted in partial and one in complete failure; leaving about three successes out of every four cases. Simon had three complete failures out of fifteen cases. Whitehead has himself operated upon two cases of congenital fissure with admirable success. If Warren's statements are to be received—and no one has called them in question—his success was quite equal to that obtained by Langenbeck's method, since he affirms, "I have succeeded in completely closing a very large proportion of all the fissures upon which I operated, including some very extensive ones, and thus established the operation as a perfectly practicable one."[2]

Nevertheless he declares that he has ceased of late years to operate for the closure of the anterior portion of the cleft in extreme cases, preferring to leave these openings to be closed by artificial obturators.

It has seemed necessary, in justice to my deceased friend and countryman, to say thus much of the relative claims of these several operators, Warren, Fergusson, and Langenbeck, in order that my readers may judge to whom the world is hereafter to be especially indebted for the relief of this deformity. I have not assumed to decide the question. If the operation of the great Prussian surgeon shall prove itself capable, by such testimony as the laws of science exact, of reproducing the bony vault, and of closing a larger proportion of fissures than could be closed by Warren's method, or if Fergusson or Pollock shall establish, by more successful results, the advantage of subcutaneous myotomy over external myotomy in the operation of staphyloraphy, we shall not hesitate to acknowledge their claims.

As to the influence of the operation of uranoplasty upon the voice and articulation, when successful, it is all that could be desired. The closure of an opening in the bony palate, whether by uranoplasty or by an artificial obturator, effects a complete restoration, provided

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[1] Fergusson, *Lectures on the Progress of Anatomy and Surgery*. London, 1868, p. 74

[2] Warren's *Surgical Cases and Operations*, p. 130. Boston, 1867.

ere is no defect in the soft palate, or in any of the other organs of
ech.

The same cannot be said, however, of the operations for the restoration
the soft palate. This organ never can be restored to its normal
m; its flexibility is impaired, and its muscles are nearly or quite
ralyzed by any operation which has yet been made; articulation be-
nes in some cases a little more distinct, and perhaps less sonorous,
the peculiar nasal sound continues, in all the cases which have come
ler my notice, almost wholly unchanged. Subsequent careful train-
will perhaps accomplish some improvement, but not much. In
se examples in which both a fissure of the hard and of the soft pal-
has been closed, the patients experience generally a positive advan-
e, in that they are no longer annoyed by the dripping from the
es, deglutition is effected with more certainty and comfort, and they
relieved from an uncomfortable sensation of dryness in the nares
l fauces.

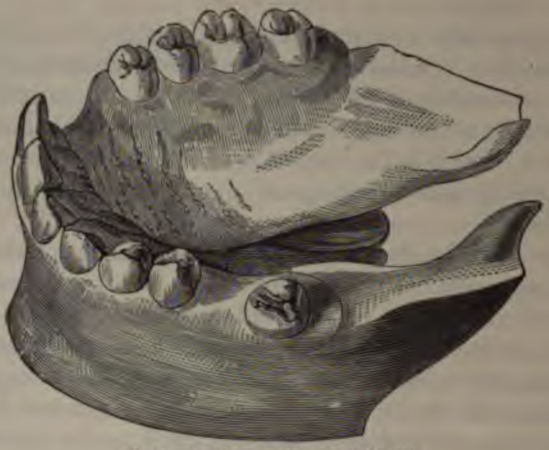
Where surgery fails in so many essential points, it is a just matter of
gratulation that ingenious mechanical contrivances have contributed
a little to the relief of the sufferers. There are certainly a few ex-
tional cases, in which the chasm is remarkably wide and extensive;
l still others, in which the condition of the patient, or an unconquer-
e fear or repugnance to a surgical operation, renders mechanical ex-
lients desirable.

To Norman W. Kingsley, dentist, of this city, we are indebted for the
st complete artificial palate which has yet been devised. It is
structed of vulcanized rubber, and may be employed as a simple
urator—a substitute for the hard palate—or as a substitute for
soft palate, or for both when the fissure extends through both hard
l soft palate. It is flexible, moving with the muscles in the act of
glutition; it is easily adjusted and removed by the patient himself;
s worn without any sense of discomfort; and improves the tone and
ver of articulation in a marked degree. The apparatus makes no
eral pressure upon the sides of the fissure, and therefore cannot, as
ne have apprehended, prevent in any degree the tendency in the
ure to close in the progress of the growth of the bones.

Mr. Pollock, surgeon to St. George's Hospital, London, who is well
wn for his large experience in this class of operations, addressing
Odontological Society of London, says of Kingsley's artificial
ate: "I look upon it as one of a series of those very great improve-
nts that have come from the other side of the Atlantic, which have
ferred so much benefit on mankind. I cannot but feel, from the
erience I have had in the treatment of congenital cleft palate, that
operation for closing it by surgical means is not always a satisfac-
r operation. There are a few cases which certainly offer every
ility and every advantage for the operation, and in those few cases
do succeed, in time, in procuring a considerable amelioration, if not

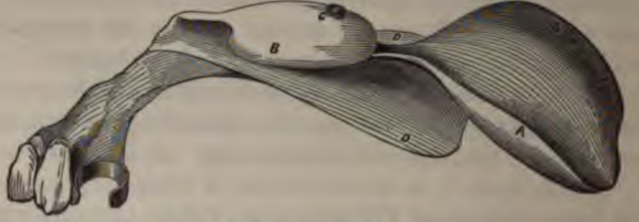
almost perfection in articulation. There is very often a large aperture between the mouth and the nares, which produces a most disagreeable cavernous *resonant sound* in the voice. That has been very much modified by operation in more than one instance, without, I may say, much material improvement in the articulation. So much with regard to the operation; but I am sure everybody in this room who has witnessed any number of congenital clefts will feel with me, that there is a class of cases in which a surgeon would not only be rash, but he would be very much to blame if he undertook an operation. I allude to those cases in which the soft palate is what you may call thin and deficient in quantity, in which the uvula is but a small point projecting on either side from a little curtain, which is drawn up on each side of the fauces. I have myself refused to operate in more than one such instance."

Fig. 334.



Model of a Fissure of the Hard Palate.

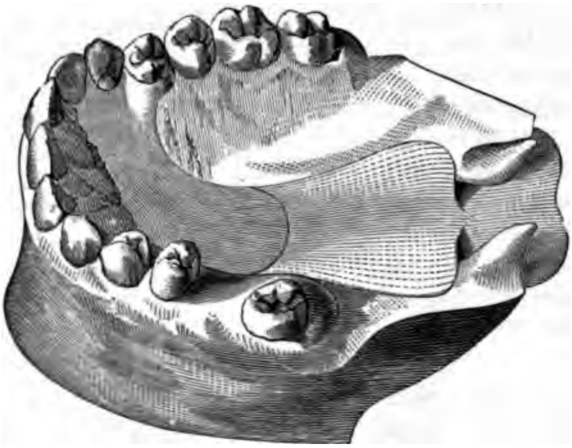
Fig. 335.



Kingsley's Artificial Palate.

The portion of the apparatus holding the two artificial teeth, and by which it is secured to the adjacent natural teeth, is made of hard vulcanized rubber. The remainder is made of elastic vulcanized rubber; the two portions being connected by a gold pin. The expanded, portion B, rests upon the floor of the nares; while the broad and floating wings, A A, and D D, are applied to the posterior and anterior surfaces respectively of the vestige of the palate, embracing it closely, and remaining subject to all its movements.

Fig. 336.



Kingsley's Artificial Palate in place.

Other Plastic Operations upon the Lips and Mouth, usually denominated Cheiloplastic.

In consequence of burns and various forms of phagedenic ulcerations, but more often in consequencee of the loss of tissue resulting from the removal of an epithelioma, both lips—but more especially the lower lip and the commissures—demand the interference of plastic surgery.

It is impossible, except in a very general way, to indicate all the various forms of incisions which will be required for these cases. A few leading principles only will be stated.

The elasticity and vitality of all the tissues surrounding the mouth is such that very large chasms may be successfully closed with what might seem to be very insufficient material. Thus, for example, the surgeon seldom finds it difficult to bring together the opposing raw surfaces, and make them unite, when, for an epithelioma, he has removed, by a V-shaped incision, three-fourths of the lower lip.

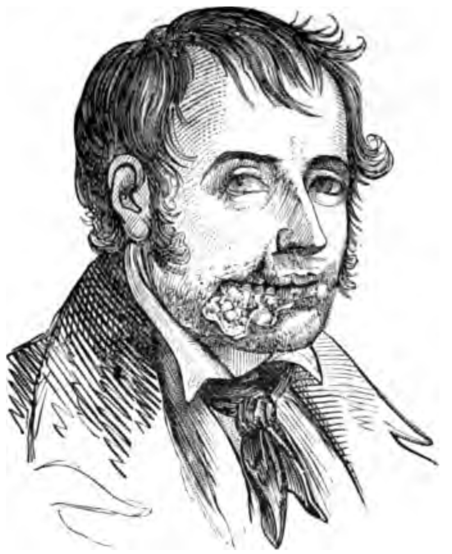
In case the entire lower lip has to be restored, the necessary material may be obtained by parallel lateral incisions and sliding the flaps together; or, as I have generally practised in such cases, by taking integument from the sides of the neck, or from the sides and front, extending the incisions underneath the chin, and transferring these tissues by partial torsion to the position of the lower lip. This latter method is the most satisfactory in case no portion of the flaps is lost by sloughing; but the flaps thus constructed are necessarily long, and the skin of the neck having less vascularity than the skin of the face, care must therefore be taken that the base of each flap is broad and thick, and that they are not brought together with much strain.

If an operation is made to enlarge the commissures of the mouth, it will be necessary to cover one of the raw surfaces with mucous membrane, or the commissure will close again to the same point at which it was closed before. This is done by dissecting up the membrane, including a little of the submucous structures, and stitching it over to the integument upon the outer side. It is not necessary to cover both of the raw surfaces; and the lower lip is generally chosen, as being that upon which the prolabium is naturally most exposed.

Epithelioma of the Lips.—The lower lip is a favorite seat of epithelioma; the disease occurring generally after the middle period of life, especially among the intemperate and among laborers who live much out of doors. Those who habitually use a pipe often have an epithelioma developed at the point of the lip upon which the pipe usually rests. It occurs much more frequently in men than in women.

Epithelioma of the lip may commence as a slight mucous abrasion, whose margins and base soon become indurated; as a fissure in the centre of the lip, with indurated edges; as a wart; as a brown crust, with underlying induration; or, finally, as a small, hard, round, and at first movable tumor in the substance of the lip, feeling at this period like a small shot.

Fig. 337.



Ulcerated Epithelioma of Lower Lip.

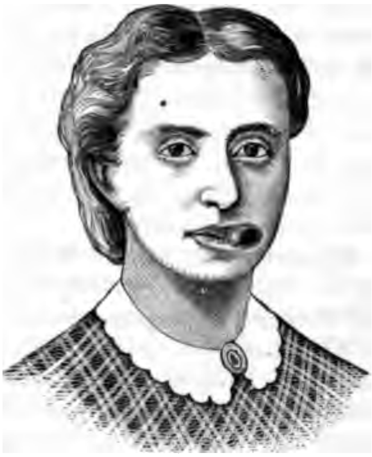
During the winter of 1869–70 I found in my wards at Bellevue Hospital a man having a chancre upon his lower lip, contracted by using a clay pipe which had just been taken from the mouth of his room-mate, then laboring under secondary syphilis. It presented so much the appearance of an epithelioma that on my first inspection I declared it to be such; but further inquiry and examination established its true character. He was immediately placed under treatment, and about six weeks later he had a characteristic roseolar eruption. This mistake has often been committed, and it is important that the surgeon should be reminded of its possible occurrence. It is possible also to confound a case of psoriasis labialis with epithelioma.

Treatment.—Occasionally I have seen this malady cured by certain caustic applications; but where one has been treated successfully by this ethod, ten have become larger and more intractable. Such cases are onstantly presented at our large hospitals; and the experience of all urgeons connected with these institutions confirms the statement that he knife is the only reliable resort; and further, that if an epithelioma f the lip is removed very early and thoroughly, it seldom returns.

Hypertrophy of the Labial Glands is not unfrequently seen in trumous children, forming hard, irregular nodules in the substance f the prolabium, which occasionally form vesicles which burst and lcerate, leaving crusts. Attention to the general health, and the se of mild mercurial unguents, constitute the appropriate treatment.

Erectile Tumors of the Lips may be recognized by their elasticity nd compressibility, and in general y the bluish color of the surace. When small, they are most romptly and satisfactorily cured y a V-shaped incision; but, if hey involve a large portion of he lip, the ligature or electrolysis s to be preferred.

Fig. 338.



Erectile Tumor of the Lip. Removed by the Author.

Hypertrophy of the Lips.—As a consequence of some longontinued local irritation, the lips nay become permanently hyperrophied, demanding the removal y excision of a transverse elliptial piece. More frequently a natural defect is observed, the mucous membrane covering the inner portions of the prolabium of both the upper and lower lips projecting and forming a long, unsightly fold. Excision of the fold along the inner border of the lip effectually relieves this deformity.

CHAPTER VI.

SURGERY OF THE BUCCAL CAVITY.

Tongue-Tie. Syn., Lingua Frenata, R. C.; Filet.—Surgeons and physicians, by dint of much argument, and some fatal mishaps, have at length succeeded pretty well in persuading mothers that division of the frænum linguæ is not demanded in every case in which the infant cannot or will not nurse. It is doubtful whether the condition of the frænum ever interferes with nursing; since it is by no means necessary that the child should lift the apex of the tongue to accomplish this act. It is enough if the central and anterior portion can be lifted into contact with the roof, or sufficiently to compress the nipple, and it has never happened to me to see an infant who could not do this.

If the surgeon believes, however, that the frænum does interfere, let him be reminded of the four examples recorded by Velpeau, in which, from the accidental wounding of the ranine artery, the little patients have bled to death. I have myself seen one infant narrowly escape death from hæmorrhage after wounding the ranine artery in this operation.

The only method of operation which can be pronounced wholly free from danger is, to cut the mucous membrane covering the free margin of the frænum with the knife or blunt scissors, and to complete the operation by tearing the frænum with the finger-nail. If the operation should require to be completed with a cutting instrument, the tongue may be raised by the two rings upon the handle of a pair of scissors, and the incisions made toward the inferior maxilla, and not in the direction of the tongue.

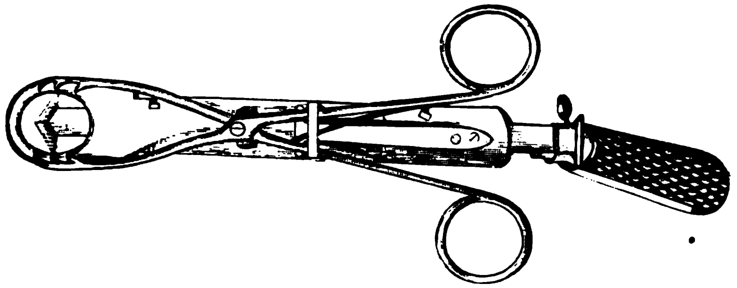
Hypertrophy of the Tonsils. Syn., Tonsillæ Intumescentes, R. C.—Simple hypertrophy of the tonsils may exist at any period, but the attention of surgeons is most often called to these cases between the third and seventh years of life. Occasionally they are found enlarged in infancy; but we seldom meet with this condition after the thirtieth year. In fact, the enlargement, which may be considerable in early childhood, usually begins to diminish at about the tenth or twelfth year, so that by the eighteenth or twentieth the glands are reduced to nearly or quite their normal size. Children who have enlarged tonsils have generally a strumous diathesis; but while it is true that this condition of hypertrophy depends essentially, perhaps wholly, upon some constitutional dyscrasy, it is certain, also, that in not a few cases the general health is made to suffer in consequence of this local affection, and especially when the hypertrophied glands are subject to frequent attacks of acute inflammation.

Treatment.—Such therapeutic and hygienic measures as improve the health and vigor of the body are always required, and will sometimes, in themselves alone, be found sufficient to accomplish a cure. Local applications, such as the nitrate of silver, the tincture of iodine, etc., of which some surgeons have spoken favorably, have never seemed, in my experience, to be of any service. Excision is, therefore, the only properly surgical remedy deserving consideration.

The circumstances demanding an operation are: the frequent recurrence of inflammation in the enlarged tonsils; deafness, induced by pressure upon the orifice of the Eustachian tube; continued embarrassment in respiration during sleep, and interference with deglutition. It is imprudent to practise excision when the tonsils are inflamed, and in persons having a marked hæmorrhagic diathesis. With infants the operation is somewhat more difficult than with children or adults, owing to the smallness of the mouth; and, fortunately, the operation is not often required at this period of life.

The instrument which I have employed for many years is a modification of the tonsillotome devised by Owen, of Albany.

Fig. 889.



The Author's Tonsillotome.

There are several points involved in the proper construction of a tonsillotome which it is proper to enumerate. The handle should be firm, nd set upon the shaft at an angle greater than a right angle; the shaft hould be strong, and wide enough to separate the teeth and protect he finger of the operator; the tonsil should be seized by forceps ather than by a pin, so that it may be brought out with the instrunent—a pin, and all those forceps operating by the action of a spring, ften tear out; the edge of the knife must be lance-shaped, so as to penetrate first by its point; it should be made to enter by propulsion, effected by the thumb of the hand which holds the instrument, and not by retraction, and with the opposite hand—a method which renders the ntagonism unequal and unsteady.

The patient being seated, the instrument is introduced, and the ring djusted to the gland on its inner and lower aspect. The gland is sually elongated in its vertical diameter, and drops into the ring easily f approached from below. With the index finger of the left hand n the case of the left tonsil) the surgeon ascertains that the gland is mbraced by the ring; then with the thumb and forefinger of the same and the forceps are closed, the gland drawn through, and immediately, ith the thumb of the right hand, the knife is projected and the excison accomplished. Usually only a moderate hæmorrhage follows the peration. If excessive, it may be restrained by an ice-water gargle, or y placing around the neck a cloth saturated with ice-water. I have sed for this purpose, in winter, a snow-cravat, rolling the snow in a eckcloth and wrapping it around the neck. Of the hundreds of cases in which I have made this operation, only twice has the bleeding been excessive, or such as to cause faintness.

My practice is to remove the entire gland, if possible, since the bleeding is certainly no greater when this is done than when the gland is partially excised; indeed I have sometimes thought a bisection was followed by more profuse bleeding than total excision. Moreover, if any considerable portion of the gland is left, it is exceedingly liable to again become hypertrophied.

Malignant Disease of the Tonsils.—True carcinoma, or scirrhus of the tonsils, I have never seen; but soft cancer, and especially that variety denominated by Burns "fungus hæmatodes," has been noticed by me three times. The period of life between the fifteenth and thirtieth years appears to present the greatest liability.

No prudent surgeon would attempt the removal of a tumor of this character in this situation. Ligature of the carotid has been practised in one case under my observation, with the result only of delaying for a few days the fatal issue. Surgery, therefore, offers no expedients worthy of a trial.

Abscess of the Tonsils.—As a result of acute tonsillitis, suppuration is very apt to occur in the adjacent connective tissue, or in the structure of the tonsil itself. It is seldom that pus can be found, by explorative incision, earlier than the sixth or seventh day. If, however, the patient has had a previous attack of suppurating tonsillitis, the pus forms usually a little earlier, perhaps on the fourth or fifth day.

These abscesses may be opened by a long, narrow bistoury, care being taken to direct the point of the instrument backwards, and not backwards and outwards, lest the internal carotid artery should be wounded; an accident which has happened in more than one instance.

As to the treatment of an attack of acute tonsillitis, or "quinsy," prior to the occurrence of suppuration, a single active cathartic has most often succeeded in arresting its progress. Cool mucilaginous drinks are also often useful; but stimulating gargles, applications of nitrate of silver, and scarifications, which have been said to prove useful in the hands of others, have never failed to do mischief in those cases which have come under my observation.

Elongation of the Uvula.—In consequence of acute inflammation, the uvula is occasionally swollen and elongated. Generally the swelling is of an œdematous character. It may be relieved by mucilaginous or mildly astringent gargles; but scarification, or cutting off a very small portion of the end with the scissors, gives the most prompt relief. When it is permanently elongated by chronic inflammation, or in consequence of a relaxed condition of the levator palati, it may become necessary to shorten it by excision. The uvula performs important functions in the closure of the nares during deglutition, and in phonation, and the surgeon must take care not to remove too much. I have usually performed this operation with my tonsillotome, by simply allowing the uvula to fall into the ring, and then quickly projecting upon it the guillotine. The cutting edge must be in perfect order, or a portion of the mucous membrane will remain uncut.

Tumors of the Mouth.

Ranula; or Encysted Tumors of the Ducts of either the Submaxillary or Sublingual Glands. Syn., Batrachos; Frog-tongue. —The term ranula, from the Latin *rana*, has by some writers been restricted to a tumor resulting from an obstruction of Wharton's duct, and by others to obstructions of the sublingual ducts. There is sufficient evidence, however, that a tumor answering to the description of a ranula is found occasionally in the duct of the submaxillary gland, and sometimes, also, in the ducts of the sublingual. Serous cysts may also arise in the substance of either of these glands, probably in their connective tissue, independent of their ducts. Tumors having some points of resemblance to ranula may originate in obstructed muciparous glands. Finally, there are many examples of enlarged submaxillary bursæ, which very much resemble a ranula in their external appearance. It is proposed, however, to limit the term to obstructions of the ducts of the submaxillary and sublingual glands. To the other forms of encysted tumors resembling ranula, the term "spurious" may be conveniently applied.

The differential diagnosis between these various forms is usually attended with so many difficulties, that it seems proper to make a brief allusion to the anatomy and situation of the submaxillary and sublingual glands.

The submaxillary glands are situated below the inferior maxilla, in the anterior portions of the submaxillary triangles. They are covered by the integument, the platysma myoides muscles and the deep cervical fascia. The duct of each gland, called the duct of Wharton, commences by numerous radicals within the substance of the gland, forming a single tube of about two inches in length, with walls much thinner than those of the parotid duct, and terminates in a narrow orifice on the summit of a small papilla at the side of the frænum linguæ.

The sublingual glands are the smallest of the true salivary glands, weighing, usually, about one drachm. They are situated beneath the mucous membrane of the floor of the mouth, on each side of the frænum linguæ, reaching from the anterior margin of the submaxillary gland to the symphysis mentis. Their ducts—of which there are from eighteen to twenty for each gland—open into the mouth on the elevated crests of mucous membrane caused by the projections of the glands on each side of the frænum.

While in some cases an exact differential diagnosis may be impossible, it is not difficult, in many examples of tumors presenting the general appearance of ranula, to determine the organ or structure to which they connective tissue in this region are not translucent. They lie usually more deeply, and contain serum only very slightly colored, and possibly some phosphates or calcareous concretions. Finally, tumors occasioned by enlargement of bursæ lie deeper from the floor of the mouth, projecting less into its cavity, and much more below the chin. They contain a clear serum, or serum colored by more or less blood corpuscles. These are sometimes congenital.

It may be proper to call attention again to the fact, that I have enumerated two forms of true ranula; one in which the obstruction of the duct takes place at or near its orifice, and which is characterized by a translucent sublingual tumor, accompanied with more or less projection below the chin; and a second, in which the obstruction occurs at or near the gland, and there is no translucent sublingual tumor, but only a general uplifting of the floor of the mouth, and much greater prominence of the tumor below the chin.

There is also a third condition, to which I have elsewhere called attention, in which the obstruction occurring in any portion of the duct is partial and temporary, and does not occasion, properly speaking, an encysted tumor, but a sudden dilatation of all the radicles situated within the gland, causing the gland to enlarge, especially during the act of mastication. In such cases, as in one example cited, an active cathartic may accomplish relief; or the fluid may be expressed by pressure upon the gland. If, however, the obstruction is continued a sufficient length of time, the walls of the duct yield at one point or another, and a cyst is formed.

Treatment.—The treatment of that form of true ranula caused by obstruction at or near the orifice of the ducts, consists in opening the sac, evacuating its contents, and maintaining or re-establishing the orifice. It has been observed, however, that the fistulous orifice thus made cannot always be maintained if the sac is simply incised; but that it is often necessary to remove a large portion of the sac, so as to prevent the edges from falling into contact; and that a successful result is more certainly insured by cauterizing the edges and interior of the sac, and then laying a bit of lint between the edges of the wound.

In case the obstruction is at or near the gland, and the substance of the gland itself is involved in the tumor—as may be indicated by the fact that the tumor does not present the usual translucent appearance under the tongue, but seems to lie deep under the floor of the mouth, projecting chiefly beneath the chin, between it and the hyoid bone—then it will be more prudent to open the sac from the most salient point below the chin; and after the lapse of several days, when the sac has been thoroughly drained, to seek to destroy its secreting surface by injections of tincture of iodine, tents, etc. Opening the sac from the mouth, under these circumstances, is attended with the hazard of hæmorrhage, and, as it must be kept open a long time, it is exceedingly annoying to the patient; it is, also, more difficult to maintain the fistu lous orifice; and finally, it is not so likely to result in a complete obliteration of both the duct and the gland, which must now be the chief point to be attained. Moreover, it is this form of ranula which is most likely to be confounded with simple serous cysts developed in the substance of the gland, or in the connective tissue adjacent, or with bursal tumors, in either of which latter cases, complete destruction of the secreting surfaces, and not the re-establishment of the original canal, is to be desired. The destruction of the cyst can be accomplished with the most certainty through an external, free, and depending opening. It is true, however, that in the case of simple cysts, here as elsewhere, it is preferable to remove the cyst entire by dissection; but the difficulty in any case of making an accurate diagnosis, and the embarrassments which often attend the destruction of encysted tumors in this region, will generally justify the surgeon in resorting to incision rather than excision.

Finally, the treatment of these various tumors, including ranula, properly so called, and spurious ranula, may be summed up as follows: —In case of a well-characterized, translucent ranula, presenting itself almost exclusively within the mouth, an attempt must be made to re-establish the opening of the duct by free excision of the projecting portions. In case of a deep-seated ranula, probably involving the gland, it is more prudent to open from the integument; and success is more certainly insured by continual suppuration, causing thereby a destruction of both the duct and the remnant of the gland itself. In case of a bursa, the same course should be pursued as in the deep-seated ranula. And while in case of a simple serous cyst, formed either in the gland or the adjacent connective tissue, if the diagnosis were complete, it might be proper to attempt its extirpation by dissection; yet, considering the difficulty of diagnosis, the hazards and difficulties of the operation, and the generally successful results of incision followed by injections, the latter course must, in most cases, commend itself to the prudent surgeon; that is, the same treatment is recommended as for a deep-seated ranula, or a bursa.

Encysted Tumors of the Parotid Gland and of its Ducts.—The parotid gland, situated upon the side of the face in front of the ear, is the largest of all the salivary glands. Its excretory duct, originating by numerous radicles, unite within the substance of the gland to form a common duct, which passes almost directly forwards over the masseter, penetrates the buccinator, and, after coursing a short distance between the buccinator and mucous membrane, enters the buccal cavity opposite the second molar of the upper jaw. Its walls are dense, consisting of an outer or fibrous coat containing contractile fibres, and an inner or mucous coat lined with columnar epithelium. The canal is about the size of a crow-quill.

Obstructions of the duct of Steno have not hitherto been classified as tumors; and probably for the reason that they cannot in any case be ubjected to the same treatment which is applicable to other tumors—hey can never be properly treated by extirpation—the only approved urgical expedient is to attempt the re-establishment of the communica-ion with the buccal cavity; but the same objection would hold good gainst recognizing obstruction of the ducts of the submaxillary and of he sublingual glands as tumors. I prefer to consider these obstruc-ions in this connection.

Obstruction of the Duct of Steno at its Orifice.—Occasionally, as he result of abrasion and consequent adhesion of the mucous membrane t the point where the duct opens into the mouth, a small pellucid umor is formed under the mucous lining, which, after a time, opens pontaneously, and a cure is effected.

Obstructions of the Duct of Steno in its Continuity, from Adhe-ions caused by Wounds, Ulcerations, Gangrene, etc., sometimes occur, giving rise in some cases to a temporary elastic, oblong elevation on he side of the face; but the saliva soon makes a way for itself through he unsound tissues, and causes a fistula upon the side of the face vhich is exceedingly difficult to close.

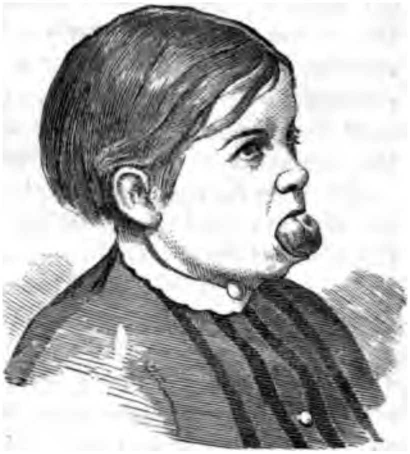
There is, perhaps, no better plan of treatment than to pass a pretty arge silk seton through the orifice of the fistula into the mouth—tying ts two ends upon the cheek—which, after the lapse of two or three veeks, may be removed, and the fistula closed externally by freshening ts edges and uniting them with silver sutures.

Encysted Tumors from Calculi in the Duct of Steno.—These umors present themselves as hard, oblong nodules on the inside of the nouth; or the tumor may be elastic, with a hard, central nucleus, the presence of the calculus having caused inflammation and adhesion of he walls of the duct, so that the sac contains saliva and pus as well as he calculus. These calculi are generally composed of the phosphate of lime, with a triple phosphate. They must be laid open, and the calculus removed from the inside of the mouth, so as to avoid an external alivary fistula.

Encysted Tumors Caused by Obstructions of the Ducts of the Labial, Buccal, Lingual or Pharyngeal Glands, and Follicles of the Mouth.—The labial, belonging also to the system of salivary glands, re situated beneath the mucous membrane covering the orifice of the nouth, and especially upon the inner surface of the lips. They are ounded in form, of about the size of a small pea, and open by ninute orifices upon the surface of the mucous membrane. The buccal glands—similar to the labial, but smaller—are situated between the nucous membrane and buccinator muscle, except two or three called nolar glands which lie between the masseter and buccinator; these atter are somewhat larger than the submucous buccal glands, and their lucts open opposite the last molar teeth. There are also a few small glands of the same character under the mucous membrane of the osterior half of the hard palate; those of the under surface of the soft ecomes everted, the central lower teeth project horizontally, and even he inferior maxilla is sometimes changed in form.

When, in a case of hypertrophy from glossitis, all other means have ailed, and also in most cases of conenital hypertrophy, it will be neessary to diminish the length and iickness of the tongue by an operaon.

Fig. 340.



Congenital Hypertrophy of the Tongue.—Buck.

Dr. Buck, in his report of the ase illustrated by the accompanying ood-cut, states that he found the icreased thickness in the vertical iameter of the tongue a more seous impediment to its return within ie mouth than its transverse expanon; and that, having made the sual vertical V-shaped incision, he ound it necessary, subsequently, to emove another portion by a horizonl V incision, and he would recomend that hereafter this latter method of incision should in all cases e adopted.[1]

In making the operation it is advisable, in order to avoid all danger f a recession of the stump within the mouth before the vessels are seured, to transfix the tongue on each side, beyond the point of contemlated incision, with two strong ligatures, which must be held by an sistant until the operation is completed. In case the method of ablaon by the horizontal incision is adopted, the surgeon will seize the end f the tongue laterally with a vulsellum, so as to increase the thickness f the vertical diameter; but if the method by the vertical incision is osen, the end of the tongue should be seized in the direction of its pper and lower surfaces. Three or four arteries will generally reuire the ligature; and, after these are secured, the flaps must be aproximated and closed by strong silk sutures, thrust deeply into the ructures.

Epithelioma of the Tongue; originating, in most cases, as a papilform elevation upon the side of the tongue near its apex, or as a subucous induration, but occasionally as an ulcer which has been caused y the chafing of a ragged or carious tooth.

Treatment.—There is no remedy deserving a trial except thorough exsion; and even this offers little or no ground for hope if the disease very extensive, or if the floor of the mouth, the bones, or the sublinual glands are involved. When near the apex of the tongue it may be moved by the knife; but no surgeon who has once attempted the removal of even a small portion of the tongue for an epithelioma will omit to make, for this apparently trivial operation, the most ample preparation. A good light will be required, and two or three intelligent assistants; a variety of hooks, forceps, and large needles with and without handles; strong silk ligatures, ice-water, and the persulphate of iron, or even the red-hot iron, as preparations for hæmorrhage. Occasionally, also, it may be necessary to employ a gag, for which purpose a piece of soft wood, of sufficient length and breadth, will be found the most convenient. I have used in these operations both the knife and the écraseur, and, with good assistants and a complete supply of instruments, I prefer the knife. The écraseur is applied with difficulty, unless the entire end of the tongue is included; it often fails to embrace the whole of the diseased structure; and the amount of bleeding is not by its use always very much lessened, sometimes not at all. If one feels doubtful of his ability to control the bleeding after excision, then ligation with a strong saddler's whip-cord is to be preferred. Hilton divided the gustatory nerve before applying the ligature; but this is scarcely necessary, since, when the ligature is well tightened, the pain soon ceases. In order to apply the ligature securely it will be necessary to carry it through the sound structures, beyond the limits of the disease, with a large needle. In some cases it is sufficient to transfix the tongue once and tie the cord upon both sides. In others the needle must be carried through several times, or two or three separate ligatures must be employed.

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[1] Buck. *The Med. Record.* New York, Jan. 2, 1871.

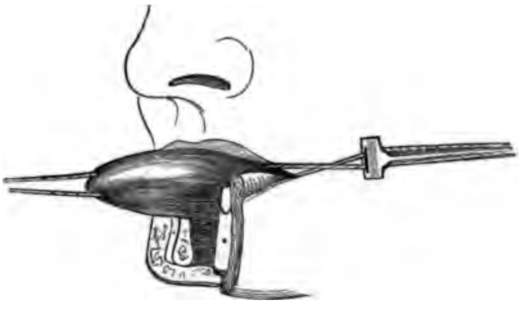
Considerable swelling, accompanied with some difficulty in deglutition, almost invariably follows the operation. There is also profuse salivation, with a very abundant secretion of mucus from the pharynx and larynx. To diminish these secretions, and correct the excessive fetor, I have employed with advantage a weak solution of the chlorinate of soda, or a few drops of the tincture of myrrh in water.

When the disease involves the middle or posterior portions of the tongue, attempts have still been made to arrest its progress by the removal of two-thirds or the whole of the tongue; and it is said that these bold efforts have sometimes proved successful. In one case, however, which has come to my knowledge recently, the unfortunate man died upon the table before the operation was completed. It is certain, also, that most of the cases have terminated fatally in a very short time; and, notwithstanding the statements to the contrary, I must be permitted, for the present, to doubt whether any have made a complete and final recovery. Such attempts to rescue these poor sufferers do not best illustrate the principles and purposes of our art, and will not often, I think, be imitated by good surgeons.

The estimate which I place upon these operations will not justify a very detailed account of the various procedures which have been adopted. The following explanations will suffice:—

Mr. Syme divides the soft parts by a vertical incision, extending from ie top and centre of the lower lip downward to the hyoid bone. The iferior maxilla is then rforated on each side the symphysis, to ad- it of the passage of a lver wire. The sym- hysis is next divided by ie saw, the mylo-hyoid, ie genio-hyoid, and the nio-hyo-glossi muscles e detached from the w; when the tongue ay be drawn forwards id removed by a single roke of the knife, down to its attachments to the hyoid bone; or, as iggested and practised by Heath, in making the section of the tongue, ie écraseur may be substituted for the knife. It will only remain secure the arteries, unite the two halves of the inferior maxilla with lver wire, and close the tegumentary wound.

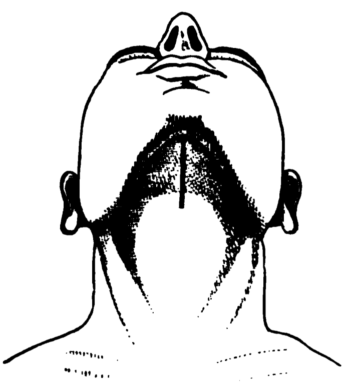
Fig. 341.



Syme's operation, modified by Heath.

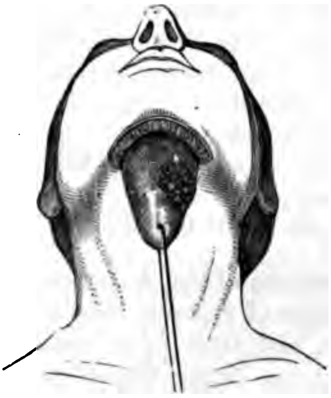
Regnoli makes an incision along the base of the lower jaw, from near ie angle to the other; and a second, vertical incision, from the mphysis to the hyoid bone. Dissecting up the triangular flaps thus rmed, he opens into the floor of the mouth, when the tongue is seized, rawn out, and its separation effected either with the knife or with the raseur.

Fig. 342.



Incisions in Regnoli's operation.

Fig. 343.



Tongue drawn out.

Of the two methods, that of Regnoli is to be preferred; and if the erations were made for the purpose of removing an epithelioma hich did not involve a large amount of structure, or for any other rm of disease not demanding the ablation of the entire tongue or its eater part, it might be regarded as justifiable, since it would, perhaps, lessen the danger from hæmorrhage, and at the same time offer a reasonable hope of success. We beg the reader to understand that the term "success," here as elsewhere, in surgery, has properly no reference to the successful closure of the wound, but that it has reference solely to the purpose for which the operation is made. If the disease returns, and certainly if its return is only delayed a little beyond the healing of the wound, the operation must be said to be unsuccessful.

Erectile Tumors of the tongue occur most frequently in childhood and youth. Sometimes they are congenital. Their most frequent seat is near the tip of the tongue. They may be recognized by the smooth, uniform elastic or compressible swelling, unattended with pain or soreness; and, when situated near the surface, they have usually a purplish color. Under either mental or physical excitement, the size of these tumors is generally increased.

Treatment.— I have preferred in these cases ligation effected by means of a strong silk cord. Dr. Gross has treated them successfully with Vienna paste. Electrolysis has also been recommended and practised successfully. Whichever method is adopted, the surgeon must anticipate considerable inflammation as a result of the operation; but this speedily declines on the occurrence of suppuration. If the first operation proves unsuccessful in removing all traces of the erectile tissue, it must be repeated. Ligation of the lingual arteries has been practised as a remedial measure, and as a substitute for excision, but the results have not been such as to encourage its repetition.

CHAPTER VII.

SURGERY OF THE MAXILLARY BONES.

Abscess of the Antrum. Syn., Abscessus Antri, R. C.—As a consequence of exposure to cold, or of the irritation occasioned by a carious tooth, and from other causes, inflammation may attack the mucous membrane lining the antrum of the superior maxilla, giving rise to a deep-seated, tensive pain, and which is usually, after a time, accompanied with considerable swelling and tenderness of the soft parts covering the cheek-bones. Unless this inflammation terminates speedily, suppuration ensues, the pus discharging itself into the nares, especially when the patient lies upon the opposite side of the face. The matter, from delay in its evacuation, is usually offensive, and of a greenish yellow color. In other cases the nasal orifice becomes closed, and the pus, being unable to escape, causes great pain, and intense febrile reaction. Abscesses which form slowly are usually accompanied with less local and general disturbance, but may give rise to a gradual expansion and thinning of the walls in all directions, so that the bones crackle like parchment under pressure made by the finger.

Treatment.—In order to give exit to the matter, the surgeon ought first to ascertain the condition of the teeth on the affected side. If either the cuspid, the bicuspid, the first or second molar is diseased, it should be extracted, and the matter will sometimes escape at once through a communication thus established with the floor of the antrum. If it does not, a pretty large steel drill may be carried through the apex of either one of these sockets into the antrum. In case all the teeth are sound, the first or second molar may be drawn, and the antrum perforated through either of their sockets. When the teeth are gone, and the alveolar sockets have also disappeared, an incision must be made opposite the root of the bicuspid or first molar, and the antrum penetrated at a point just below and in front of the malar bone.

The cavity being emptied, it should be gently syringed with tepid water rendered slightly mucilaginous with slippery elm bark. In order to insure the patulence of the orifice, a slippery elm or laminaria tent should then be introduced, the outer extremity of which must be secured by a ligature to one of the teeth. This should be removed twice daily; and after twenty-four or forty-eight hours it may be left out during the day, and re-introduced at night. Mildly astringent and deodorizing washes are suitable only when the active inflammation has somewhat subsided. I have seen great pain and an aggravation of all the symptoms induced by their early use. The patient is usually very prone, after a few days, to make suction upon the orifice made by the perforator, drawing the air from the nostrils through the antrum. This seldom fails to cause irritation in the membrane, and must be forbidden.

Dropsy of the Antrum.—It is probable that the condition usually denominated dropsy of the antrum is, in most cases, an accumulation of the natural secretion—mucus—within this cavity, in consequence of a closure of the nasal foramen. In other cases, it is affirmed that it is of the nature of an encysted growth or tumor which has formed in the structure of the lining membrane, and which is capable of indefinite development, an opinion which appears to be based chiefly upon the fact that the fluid evacuated from the expanded antrum is sometimes serous in its character; but the secretions of those mucous membranes which have by accident become shut sacs are often materially changed, so that the original character of the secreting membrane could scarcely be determined by an examination of its contents; and especially does it happen frequently that a serous exudation is substituted for the mucus. In the so-called dropsy of the antrum, the walls become expanded and thinned even more than in chronic abscess, and bend and crackle under the finger like parchment.

Treatment.—The treatment consists in an attempt to re-establish the nasal orifice by a firm and slightly-curved steel instrument introduced into the middle meatus; or, in case this proves unsuccessful, an opening may be made into the antrum from under the lip, as already directed in cases of abscess. After its thorough evacuation, moderate and long-continued pressure upon the elevated cheek-bones will encourage the contraction of the walls of the antrum, and hasten their return to their normal position.

Tumors of the Upper Jaw.—The great vascularity of all the structures composing the face renders these parts peculiarly liable to morbid growths, and determines for them, usually, a more rapid progress than characterizes similar growths in most other parts of the body. Indeed it seems probable that, for the same reason, they are more apt to assume a malignant type; so that one may always look upon tumors involving the bones of the upper jaw especially with suspicion.

The tumors of the upper jaw with which the surgeon most frequently meets are the encephaloid, myeloid, fibrous, encysted, osseous, and enchondromatous.

The *encephaloid*, having its source most often in the lining membrane of the antrum, occasionally external to the antrum, may be recognized by the rapidity of its growth, by its tendency to involve all the structures in the heterologous and degenerative transformation, by its elastic and unequal feel when it approaches the surface, and, finally, by its ulceration, and the subsequent bleeding, fungoid growths. The usual constitutional indications of a malignant cachexy are also sooner or later present. Such are the phenomena which mark the progress of encephaloid, in whatever portion of the face it may be situated; but if it originates within the antrum, it usually presses into the nares, overhangs the alveoli beneath the upper lip, lifts the floor of the orbit, or melts away the palatine bones forming the roof of the mouth, before it has caused much elevation of the malar bone or of the overlying soft parts. Thorough extirpation is a doubtful, but the sole remedy known to surgery.

A *dentigerous* or tooth-bearing cyst is usually caused by the malposition of one of the permanent teeth, in consequence of which the tooth is unable to approach the surface. In very rare instances it is due to the misplacement of a temporary tooth, or to the presence of a supernumerary tooth. It occurs most frequently in connection with the upper jaw, and especially as a consequence of the malposition of a permanent canine. The tumor commences, usually, during the period of youth, and may be recognized by its position and the absence of the corresponding tooth, by the slowness of its growth, and by the elasticity of its walls, which crackle under the pressure of the finger. If a doubt is still entertained as to its true character, it will be removed by exploration, when the tumor will be found to contain a single tooth and a serous fluid. Free incision, and removal of the offending tooth, is the proper surgical remedy.

The other forms of tumors occurring in the upper jaw, such as the *myeloid*, *fibrous*, *osseous*, and *enchondromatous*, present no features, depending solely upon their anatomical situation, which demand for them a special consideration in this connection.

Excision of the Upper Jaw.—Surgeons have from time to time indicated certain rules to govern the incisions, and the various subsequent steps of an operation for the removal of the upper jaw. If one could be supposed to have occasion to remove these bones when they were in their natural condition and relations, exact rules might properly enough be given; but when invaded by morbid growths, or when suffering under any form of disease demanding their extirpation, almost every step of the procedure must be determined by the nature, extent, and complications of the malady. I have often had occasion to remove more or less of the upper jaw, and I am certain that in no two cases has it been found convenient or proper to proceed in a similar manner.

Whenever it is practicable, the principal branches of the portio dura and the duct of Steno should be respected in the external incisions; but it is of so much less importance to avoid a scar than to be able to see thoroughly, in order to the effectual removal of all diseased structures, and for the speedy arrest of hæmorrhage, that it has never seemed to me advisable to make operations of any magnitude by simply lifting the lip, as suggested by Gross, or by restricting one's self to a median incision, as practised by Fergusson.

Dr. Gross thinks it quite useless to ligate the carotid as a preparation for this operation. I have, however, thought otherwise in most cases in which I have had occasion to operate for the removal of malignant or vascular growths of either the face or upper part of the neck which had already attained considerable size; first, because the operations have seemed to be attended with less hæmorrhage; and second, because the ligature is a proper expedient to be employed for the purpose of delaying or of preventing a recurrence of the malady. As to the effect of ligation of the carotid upon the hæmorrhage, I have made this observation. The first gush of blood from the wound does not seem to be materially lessened, but the bleeding ceases more quickly, and it is seldom that a ligature is required in the wound when the carotid has been tied. It is probable that most of the blood which escapes, under these circumstances, is retained in the vessels above the ligature, and that the bleeding rapidly ceases when these vessels are emptied. I can agree with Dr. Gross, however, in saying that without the ligature the bleeding is seldom excessive, and that after the application of cold water, and temporary pressure with the sponge, very few vessels have required to be tied. I have never been obliged to resort to a heated iron, yet it is well to have it always at hand.

The instruments required for this operation—in addition to the ordinary knives, forceps, needles, and scissors—are strong knives which will cut bone; strong straight and curved scissors; a narrow saw; bone-cutters of various forms and sizes; strong bone forceps—especially Liston's lion forceps; large needles, armed, and with handles attached, in case it becomes necessary to seize deep-seated vessels; in some cases, also, chisels, gouges and mallet, with trephines and perforators, retractors, etc. Indeed this is one of those operations in which one will scarcely know what is needed, and much of the success of the operation will depend upon the ample preparation which is made for all possible contingencies. No inconvenience generally attends the employment of anæsthetics in these cases, even when the entire upper maxilla and the corresponding portion of the roof of the mouth is removed.

When the operation of excision is completed, and all the diseased structures carefully removed, the tegumentary flaps are closed by interrupted sutures, and such other dressings are employed as may seem to be required. If the operation proves successful, the enormous chasm soon fills up nearly to its original level, and the harmony of the features is eventually in a great degree restored, except in so far as motion and expression are concerned.

Epulis.—This term is employed to designate a fibro-plastic or fibro-myeloid recurrent tumor which is occasionally seen growing from the alveoli of either the upper or lower jaw, but most frequently from the upper.

An epulis appears first as a small papilliform growth, thrusting itself up from beneath the margins of the gums. To the touch it generally feels hard, even when quite small, and by this circumstance, especially, it may be distinguished from the simple granulation, or *polypoid growths*, which occasionally project from an ulcerated alveolus. Its base is also broad and immovable. It is neither tender nor painful, nor does it increase rapidly in size; but as it progresses, the sockets, one after another, become involved, the adjacent teeth loosen and fall out, and, if permitted to grow, it fills the entire mouth, and may even cause death eventually by suffocation.

These fibro-plastic formations spring from the periosteum of the alveolus either without or within the socket; and although they are not necessarily associated with any previous diseased condition of the teeth or of the alveoli, they seldom or never occur except when a tooth, or some portion of its fang, remains in the jaw. When, however, the epulis has made some progress, the portion of the alveolus upon which it is growing is found to be expanded, softened, and porous, the neoplasm occupying its porosities, and the whole structure becoming eventually identical in character with the original periosteal tumor.

Treatment.—In the earliest stage, thorough excision of the tumor, with removal of the corresponding tooth, sometimes results in a complete cure. Nothing, however, can be considered a guarantee against its return but the removal of two or three teeth, and complete excision with the knife and saw of the affected alveoli, including a small portion of the adjacent sound bone. I have often been called upon to excise these growths after repeated partial excisions; and in one or two cases the disease had at length so far involved the neighboring structures that the most thorough excisions did not prevent a return of the tumor, and, in the end, a fatal result.

Hypertrophy of the Gums.—Dr. Gross and Mr. Salter have each described a case of congenital hypertrophy of the gums, accompanied with imperfect cerebral development, and abnormal conditions of the dermoid tissue in various portions of the body; in each of which examples the hypertrophy became so enormous as to prevent the closure of the lips, and to demand excision.

In 1859 I was consulted by a woman, æt. 27 years, then residing in Palmyra, N. Y., having hypertrophy of the gums, which had commenced two years before. She did not menstruate until she was twenty-four years of age, and, notwithstanding that she was almost colorless, and appeared very anæmic, she declared that she had enjoyed excellent health. Her front teeth decayed early, and were removed. Some of the back teeth were slightly decayed, but had never been painful. The hypertrophy commenced two years before she consulted me, and at that time involved all of the gums upon the inner surface of both sides of the lower jaw, back of the bicuspids On the right side the hypertrophy formed a roll the size of the index finger, burying the teeth, and projecting backwards, like a nipple, into the pharynx. On the opposite side the growth had made less progress. The subsequent course and final result of this case I am unable to state.

Tumors of the Lower Jaw.—Encephaloid, fibrous, enchondromatous and exostotic tumors occasionally originate from the lower jaw, but the *cystic tumors* are the most frequent. Their point of departure is generally the cancellated tissue of the interior of the bone; and this expansion is most often at the expense of the outer wall. Their growth is slow, and unattended with pain. They may be limited to a small portion, or they may involve the whole of the body of the jaw. The surface of a cystoid of the inferior maxilla is at first smooth and firm, but it soon becomes somewhat lobulated, and yields on pressure, giving to the finger a crackling, parchment-like sensation. The interior may be formed of a single cavity, or of many unequal cells, the walls of which are thin, membranous, cartilaginous, or bony. In the unilocular form, the contents of the cyst is, in most cases, a thin, glairy fluid; but the multilocular varieties embrace within their different cells fluids unlike in appearance and in chemical character, with usually more or less solid, fibrous, or bony structure.

When these tumors are of moderate size and unilocular in form, it is sufficient to evacuate the cyst, and maintain a free opening until the walls have contracted, and the secreting surface has become obliterated by granulations and organized connective tissue. In a case recently under my observation I have exposed and removed the thin anterior wall of the cyst; but in those examples of multilocular cystic tumors which occupy large portions of the entire diameter of the bone, nothing short of exsection will arrest their progress.

Necrosis of the Jaw from Phosphorus.—Those who are employed in the manufacture of lucifer matches are liable to a necrosis of both the upper and lower maxillary bones. The disease is said to be less frequent since the manufacturers have substituted amorphous phosphorus for the ordinary phosphorus. It was first described by Lòrinser in 1845, and was first noticed in this country by Dr. James R. Wood.[1]

"The phosphorus disease," as it has been termed, is a local poisoning, conveyed, generally, by the fumes of phosphorus, although in a few instances it has been conveyed by other modes. It is almost exclusively confined to those employed in large manufactories in the "dipping and drying" rooms, where the fumes are most abundant; it requires a long period of exposure—generally several years—before its specific effect is observed, and it has never been known to occur where all the teeth were sound. Indeed it is believed that its primary impression is always upon the pulp of the tooth; perhaps, however, it is sufficient that the periosteum should be exposed

Phosphorus necrosis commences with a pain resembling toothache, but the pain soon extends to other portions of the jaw, followed by inflammation and much swelling of the soft parts. Pus at length forms and is discharged from various orifices; the teeth loosen and fall out, and the probe reveals denudation and necrosis of the bone. The extent of the necrosis varies in different cases, but it is seldom limited to an inconsiderable portion; and, when it attacks the lower jaw, it has occasionally involved the entire bone. In the case of the superior maxilla, the necrosed fragments usually separate and come away in detached pieces, no new bone being formed; but when the inferior maxilla is the seat of the malady, spontaneous separation occurs only at the point at which the necrosis is arrested, and meanwhile an abundant deposit of new bone takes place, especially along the base and inferior lateral walls, so that it is with some difficulty that the sequestrum is removed entire. In most cases the process of exfoliation is exceedingly slow, and a few of these patients finally succumb to the long-continued irritation and suppuration; but the majority recover.

Treatment.—Since no case has been reported in which the phosphorus disease has attacked persons having sound teeth, it is a proper matter of precaution to have the teeth of such as are exposed frequently examined, and either to have all decayed teeth promptly filled, or to exclude such persons from any employment involving the use of phosphorus.

As to the curative treatment, there is perhaps nothing which can be regarded as having a specific influence; but the surgeon must be governed by the rules which would apply to necrosis of the same parts occurring from any other cause. It will not be prudent to attempt the removal of the sequestrum until exfoliation is complete; and then great respect must be paid to the involucrum, as upon this the future form and usefulness of the jaw will depend. Mr. Salter observes, however, that even this, after the removal of the dead bone, gradually atrophies, leaving at last only a narrow rim of bone corresponding to the original jaw.

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[1] Wood. *New York Jour. Med.*, May, 1856.

Necrosis of the Jaw as a Sequel of Eruptive and of certain Typhoid Diseases, etc.—Mr. Salter was the first to call attention to necrosis of the jaw as a sequel of eruptive diseases, and especially of scarlatina.[1] A similar result ensues sometimes upon typhoid fevers, and upon conditions of extreme anæmia; still more rarely as a result of mercurial ptyalism, or of the internal use of arsenic.

Mr. Salter attributes its frequency in connection with the exanthems to the correlation among the various portions of the dermal system, of which the teeth constitute a part. The period most favorable for its occurrence appears to be from the third to the eighth year of life, when the nutrition and development of both the temporary and permanent teeth demand the greatest activity in the vessels of the jaw. Some weeks after the disappearance of the eruptive fever, the gums become tender, and, with only a moderate amount of swelling, suppuration ensues, and necrosis is already found to exist. Its most usual seat is in the region of the molars; and it is, in most cases, limited to that portion of the bone which contains the teeth or their germs; the base of the jaw seldom becoming involved, exfoliation takes place much more quickly than in phosphorus necrosis, and no involucrum is usually present to obstruct the removal of the sequestrum. Quite often the disease is observed to be symmetrical, occurring simultaneously or consecutively upon the corresponding and opposite sides of the jaw.

Treatment.—The treatment consists in the employment of suitable means to improve the general health; in the use of cleansing washes, and the removal, at a proper period, of the loosened sequestrum. In these cases it is remarkable how completely and quickly the bone will be re-formed from its periosteal investment. But in order to insure this, the sequestrum must not be removed until its separation is complete. In the year 1849, a lad, seven years old, was attacked with dysentery. An empiric, being called, ordered certain powders to be taken daily; on the seventh day an ulceration commenced in his mouth, which destroyed the lower lip and the tegumentary covering of the chin. Three months later, the whole of the body of the lower maxilla came away, as far back as the molars. About three months after the exfoliation took place, the jaw was found to be reproduced through the entire length of the gap, the bone being firm, thick, and well shaped; but it is scarcely necessary to say that neither the alveolar processes nor the teeth were reconstructed. Subsequently, before a class of medical students, I made a plastic operation for the restoration of the lip, attaching the flaps, which were obtained from the neck, directly to the periosteum This procedure, for which I think I may claim originality, prevented, in a great measure, displacement when contraction and cicatrization occurred; so that, with the additional aid derived from a set of artificial teeth, made by the dentist Dr. Harvey, he was able to articulate distinctly and to control the escape of saliva.[1]

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[1] Salter. *Guy's Hospital Reports*, 3d series, vol. iv.

Alveolar Abscess. Syn., Gum-boil.—There are two conditions under which these abscesses are observed:—first, in otherwise healthy persons; the abscess being formed in connection with a carious tooth, or, as happens in certain rare examples, in connection with a tooth whose pulp is dead, but in which case the death of the pulp is not associated with caries; second, in persons of a strumous, tuberculous, or syphilitic diathesis, with or without caries of the teeth, or death of the tooth-pulp.

The first of these conditions has been most often observed, and the history of the affection is briefly as follows. Inflammation is propagated from the seat of the caries to the periosteum lining the deeper portions of the socket; lymph is effused, followed by the formation of pus, which is now enclosed in a capsule constructed from the materials first effused. In consequence of the pressure of the organized and expanding pyogenic sac, the alveolar wall gives way, forming a small side pocket, and at the same time a portion of the fang of the tooth is absorbed. The whole of the intra-alveolar periosteum becomes thickened, and the tooth sensibly protrudes and is loosened in its socket. Pus continuing to form, in the case of the inferior incisors it may make for itself an outlet along the sides of the tooth, escaping beneath the gums. It is liable to follow the same course, also, when either of the single-fanged teeth are involved; but this happens very rarely when the abscess is connected with the double-fanged teeth. Occasionally, also, abscesses connected with the lower front teeth open below the chin. Abscesses connected with the upper front teeth may evacuate themselves along the sides of the teeth, or they may penetrate directly to the surface by the shortest route, open ng through the mucous membrane near its point of reflection; or again, according to Salter, in case the superior lateral incisor is affected, the pus may burrow backwards between the plates of the palatal process of the superior maxilla, and present itself at the posterior extremity of the hard palate. I have often met with examples of superior canine and incisor abscesses which have formed sinuses and depots under the periosteum of the roof of the mouth, but I can scarcely comprehend how they could follow the course described by Mr. Salter. Finally, abscesses connected with the molars often open directly, or with more or less sinuous canals, upon the integument of the face.

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[1] *Buffalo Med. Jour.*, vol. vii., p. 203.

Treatment of Alveolar Abscess.—Removal of the carious or injured tooth is the first and most important step. Occasionally it may be sufficient to remove the filling, to give ample vent to the imprisoned matter; but this will rarely be found to have answered our purposes completely, since the removal of the cause is an indication no less important than the free evacuation of the pus. When the bottom of the cavity is thoroughly exposed, the opening should be maintained by a plug made of some soft wood, introduced and retained in place a few hours of each day. If the discharge continues long after the removal of the tooth, a strong solution of the chloride of zinc should be applied to the cavity once or twice. When the abscess points toward the integument, in order to avoid an unseemly scar, the fistulous canal should be intercepted by a free incision within the mouth, over the diseased alveolus, and the opening maintained in this direction.

Excision of the Lower Jaw.—There are a few important rules to be observed in the removal of portions or the whole of the inferior maxilla, which I shall find it necessary to state somewhat briefly:—First, whenever the limitations of the disease will permit, the entire bone should not be severed. In many cases a crescentic or horizontal section of the bone will enable the surgeon to remove the diseased structure, and yet preserve the continuity of the jaw. Second, the free margin of the lip must not be divided unless the necessities of the case render it essential. Some operations may be made through the mouth, without any external incisions; and in most other cases an incision along the base of the jaw affords an ample opening. By observing this rule the surgeon avoids a wound of the labial artery, and does not so much disfigure the face. Third, if the central portion is to be removed, as preliminary to the operation, but not until after the patient is anæsthetized, a strong ligature must be carried through the apex of the tongue, and intrusted to an assistant. Unless this is done, the patient will be in imminent danger of suffocation as soon as the attachment of the genio-hyo-glossus is divided. In a recent case of excision of the entire body of the inferior maxilla, I found it necessary to have the tongue held by an assistant during the four days succeeding the operation, since, the moment the ligature was dropped, the tongue would fall back and close the glottis, threatening the patient with immediate suffocation. Fourth, in dividing the attachments upon the inner surface of the bone, a curved, strong periosteum elevator can often be advantageously substituted for the knife. Fifth, the bone-cutter can be employed well enough, after removing one or two teeth, in operating upon children, or when the bone is softened by disease; but in the adult, when the section is to be made through healthy bone, the chain saw is much to be preferred. Sixth, in removing the jaw from its articulation, after the section is made, the fragment must be drawn outwards and downwards, so as to enable the operator to clip off the coronoid process with the bone-cutters, or to divide its muscular attachments, and to permit him to approach the articulation from its anterior surface. Seventh, it may be possible to avoid wounding the trunk of the internal maxillary artery, as it passes between the ramus of the jaw and the internal lateral ligament, by careful dissection while the ramus is drawn forcibly out and backwards; but the inferior dental and other branches of the internal maxillary, which are necessarily cut, will bleed freely. In case the hæmorrhage is alarming, the carotid must be compressed until the jaw is disarticulated and the vessels are tied.

The operation being completed, the wound is to be closed by sutures; and in the course of a few months, the space previously occupied by the bone will become filled by a dense fibrous tissue; but if any considerable portion of the jaw is lost the features will be irreparably disfigured. When the whole or any portion of the jaw is excised for the removal of tumors, or for cancer, whatever care we may exercise in the preservation of the periosteum, the bone is not reproduced. It has already been stated that in cases of necrosis of the lower jaw, where the bone has been allowed to exfoliate before separation, a more fortunate result ensues; in some cases the entire bone, including its condyles, being reproduced.

In the *New York Medical Gazette* for October 24, 1868, George H. Perine, dentist, of this city, has described a very ingenious apparatus, devised by himself, composed of vulcanized rubber, for the repair of a mutilated tongue and jaw.

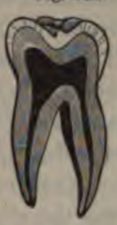
CHAPTER VIII.

ANATOMY, DEVELOPMENT, AND SURGERY OF THE TEETH.

Anatomy of the Teeth.

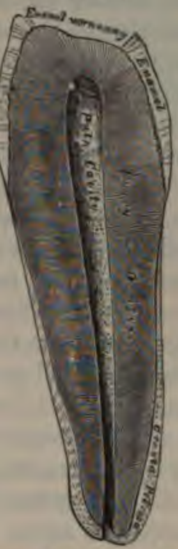
EACH tooth is composed of a crown, neck, and one or more fangs. The crown is that portion which projects above the gums, the neck is embraced by the gums, and the fangs occupy the alveolar sockets. The largest portion of each tooth is composed of dentine—ivory, or tooth-bone—a modification of bony tissue; it is penetrated by minute canals called dental or dentinal tubuli, but it has neither the canaliculi nor lacunæ which characterize true bone. The crown is covered by enamel, the hardest structure in the body. It varies, however, both in thickness and in hardness, in different persons. The enamel is covered by a membrane of exceeding tenuity, called the cuticle, which is not easily destroyed by reagents, and which probably serves in some measure to protect the enamel against the action of acids. Investing the dentine of the roots is a thin layer of true bone, named cementum, crusta petrosa, or cortical substance, which becomes thinner as we proceed from the apex toward the crown, and is finally, according to Nasmyth, lost in the enamel, with the outer surface of which, at the neck, it becomes continuous. As age advances the cementum usually increases in thickness, and may eventually undergo such a degree of hypertrophy as to encroach materially upon the alveolar sockets, and upon the cavity of the pulp, forming exostoses. In some cases, also, the pulp itself undergoes an osseous transformation. The cementum is covered by the peridental membrane, or dental periosteum, which also is continuous with the intra-alveolar periosteal membrane.

Fig. 344.



Vertical Section of a Molar Tooth.

Fig. 345,



Vertical Section of a Bicuspid Tooth. Magnified.

The interior of each tooth is hollow, its cavity expanding into a spacious sinus within the crown, and terminating in minute orifices at the apices of the fangs. These cavities contain the pulp, which is composed of blood-vessels and nervous filaments sustained by a fibrous connective tissue. Both the blood-vessels and the nerves composing the pulp enter by the small foramina at the apices of the fangs. The pulp is said to be the only portion of the tooth possessing sensibility; but, according to Mr. Tomes, the dental tubuli, which open upon and radiate from the pulp cavity, contain cylindrical prolongations of the pulp tissue, and may therefore convey sensation to the outer surface of the dentine.

Development and Diseases of the Temporary Teeth.

Development.—The temporary teeth begin to present themselves usually about the seventh month, and dentition is generally completed by the end of the second year; the teeth of the lower jaw preceding those of the upper.

The eruption of the temporary teeth is a purely physiological act, and as such ought to be accomplished without serious disturbance. The fact is, however, that among all civilized races, the process is usually one of considerable suffering and hazard. The evolution of the teeth, independent of their mechanical pressure upon the gums, seems to exalt the nervous sensibilities of the whole system in a degree sufficiently marked; but when, from any cause, the advance of the crowns toward the surface meets with unusual resistance, the most violent local and constitutional disturbances sometimes ensue. It is an error, however, to suppose that these reflex disturbances are solely a result of congestion and inflammation of the overstretched fibro-mucous membrane. They are mainly due to the indirect pressure made upon those deeper structures upon which the nutrition and development of the dental apparatus depends, and which are at this moment in a state of active hyperæmia and hyperæsthesia. The surgeon will be reminded, therefore, that an inflamed and swollen condition of the gums is not the sole indication for their incision; but that it may be, and actually is, often required when there is present neither redness, swelling, tenderness, heat, nor ptyalism. If, at the same time that the gums are tense and resisting, it is observed that the usual period for the eruption of the teeth has arrived, and the brain, stomach, bowels, or general system are characteristically disturbed, it will be proper to make free incisions. This will be best accomplished by a gum-lancet, or by an ordinary pocket-knife.

Caries of the Temporary Teeth.—The temporary teeth are no less subject to caries than the permanent, nor are its consequences any less serious, giving rise to much local and constitutional disturbance, and, in many cases, seriously compromising the health. It occurs most often in children of delicate constitutions, yet there are many apparent exceptions to this rule. It is my opinion, however, that the early destruction of the teeth, whether by caries or necrosis, always implies, even in those who appear healthy and robust, a lack of stamina, and that the physical condition of these persons in after-life will confirm the justness of these observations.

Treatment.—It is of the first importance that such children should have plenty of air, and that they should eat plain nutritious food, including, always, meat. Some surgeons entertain a belief, also, that silex and the phosphates, taken internally, exert a beneficial influence in the establishment of a healthy structure during the formation of the teeth, and they have suggested, therefore, that bread made of unbolted wheat should be given to children, rather than bread made of fine flour.

Great care must be taken to remove the salivary calculus, and especially the green tartar, which is said to be acid and erosive, and which is very prone to collect upon the teeth of children. The progress of caries should be arrested, as far as practicable, by careful excavation and filling. All these precautions having reference, perhaps, more to the future condition of the permanent, than to the preservation of the temporary teeth.

Necrosis of the Temporary Teeth.—Dental necrosis, or destruction of the entire tooth, occurs more often in the temporary than in the permanent teeth. It is generally consequent upon extensive caries which has led to the exposure and death of the pulp. The presence of the dead tooth, or of its fangs, often causes ulceration of the gums, and sometimes necrosis of portions of the alveoli; even the rudiments of the permanent teeth are sometimes carried away with the sequestrum.

Phagedenic Ulceration of the Gums.—Mr. Tomes has described an ulceration of a phagedenic character, invading originally the free margins of the gums, especially of the lower jaw, extending subsequently to the alveolar periosteum and to the cheeks, causing often extensive destruction of the soft parts, and exfoliations of considerable portions of bone. It occurs chiefly in strumous children, and in those who are poorly fed, or who live in damp and illy-ventilated apartments.

There is another form of ulceration, belonging chiefly to this period, in which the malady invades primarily the insides of the cheeks or fauces, and is preceded usually by sphacelation. The terms **Noma** and **Cancrum Oris** have, by some writers, been applied to both of these forms of ulceration.

The treatment consists in the employment of tonics and nutrients, in the prompt removal of decayed teeth, in the frequent and thorough application of disinfectants, and especially in the destruction of the ulcerating surfaces by energetic caustics.

Development and Diseases of the Permanent Teeth.

Development.—The period of the eruption of the permanent teeth is generally between the sixth and the twelfth year. The third molar, or wisdom tooth, appears much later; usually not earlier than the seventeenth year. The fangs of the temporary teeth are gradually absorbed as the new teeth advance to occupy their places, until at length nothing but the crowns remain, which, unless sooner removed, eventually drop away.

Malposition of Permanent Teeth.—The permanent teeth may present themselves out of line, in consequence of original malposition; or because the fang of a temporary tooth which has escaped absorption has been allowed to remain; or for want of sufficient room in the alveolar arcade, the teeth being out of proportion to the dimensions of the jaw.

It is not my intention to enter into a consideration of the strictly mechanical portion of dental surgery, in which so much advance has been made, and so many triumphs have been achieved during the last few years; but the surgeon needs, at least, to be informed that irregularities of the teeth, due to either of the causes above named, may be remedied by the early, continued, and judicious application of pressure. Malposition of a wisdom tooth, causing it to become imprisoned and arrested in its development, has often caused great suffering. In such cases, the only proper remedy is extraction.

Fracture of the Teeth.—When a portion of the crown of a tooth is broken off without opening into the pulp cavity, it is termed a simple fracture; but if the fracture is lower, and the cavity is laid open, it is termed compound. No serious results necessarily follow upon a simple fracture, although it is always possible that the pulp has suffered injury, and may die. In the compound fracture, however, the pulp is often torn out; but if it is not, the violent shock which it has received, together with its subsequent exposure to whatever may be received into the mouth, soon determines in it a fatal inflammation. Exceptionally, however, the pulp preserves its integrity, and seals up the aperture by the deposit upon its surface of a thin layer of dentine. In the same manner, also, by new deposits of dentine upon the interior of the pulp cavity, the pulp is protected when the tooth wears down by attrition. If, after a fracture exposing the pulp cavity, the pulp does not become enclosed, yet retains sufficient health to encourage a hope that the tooth may not be destroyed, and the tooth remains firm in its socket, the dentist ought to supply an artificial protection by a carefully adjusted filling. If the tooth is much loosened, however, it had better be extracted at once.

Teeth broken through their fangs, sometimes unite again; the new material being formed in part from the pulp, and in part from the dental periosteum, and consisting, therefore, of both dentine and cementum.

Dislocation of the Teeth.—If a sound and valuable tooth becomes accidentally displaced, the socket should be carefully cleared of blood, by a piece of soft muslin, conveyed upon the end of a probe, or by warm water injected by means of a syringe, and the tooth should be at once replaced, by pressing it firmly into its socket. The tooth will probably die, and may eventually have to be removed; but occasionally a periosteal connection appears to be re-established, and the tooth, retaining sufficient vitality to cause no inconvenience, may be worn for many years. The experiment, therefore, merits a trial.

Odontalgia.—Toothache may be purely neuralgic in its character as the result of sympathy with some remote organ—most often with the stomach—and in such cases appropriate therapeutical measures seldom fail to effect a cure, or at least to give temporary relief. In a majority of cases, however, it is due to inflammation of some of the tissues which are adjacent to, or which enclose the tooth-pulp, or to simple mechanical irritation of the pulp exposed by caries. In such cases the application of a leech to the gums may afford relief; or the pain may be allayed by the direct application of a sedative to the exposed pulp. A drop of laudanum conveyed upon a small pledget of lint is generally sufficient.

Caries. Syn., Dental Gangrene; Decay.—Caries commences, in a large majority of cases, in the apices of the sulci between the cusps, or upon some other depressed or concealed portion, where the eroding material is likely to become lodged. In exceptional cases it attacks primarily the neck, where the cementum affords a very thin covering to the dentine. This is especially apt to occur in old people.

The predisposing causes of caries are sometimes sufficiently apparent in a syphilitic, tuberculous, or scorbutic diathesis. It is often hereditary. In other cases it is evidently dependent upon long-continued and severe indigestion. The immediate causes appear to be, chiefly, the direct action of certain acids, contained in the saliva or other oral fluids, or taken as medicine or with the food; such acids acting as solvents of those portions of the teeth which possess the least vitality and the least power of resistance, namely, the enamel and the dentine. Teeth which have been extracted and replaced are subject to the same action, and even teeth composed of artificial dentine, unless highly polished, are liable to a similar decay. If from any cause the surface of a tooth becomes roughened, its liability to caries is increased. It is important, therefore, when tartar has been removed, or the file has been applied in dental operations, that extraordinary pains be taken to leave a smooth and polished surface.

We have already, when speaking of the caries of temporary teeth, alluded to the chemical theory that the habitual use of fine flour, from which the silex and the phosphates have been in a great measure excluded by bolting, is a cause of caries. Both dentine and enamel demand these elements for their proper construction; but it is probable that the system obtains in most cases an ample supply from other sources; certainly, if this were not so, the bones would be found to suffer equally with the teeth from the deficiency. The fact would seem to be, that civilization and decay of the teeth advance together, since among most savage tribes it is comparatively unknown. The inference ought to be, that caries is often due to some imperfection of the general system, which a life of out-door exercise is the best fitted to remedy.

Treatment of Caries of the Teeth.—When the teeth are once formed and fully developed, it is not probable that any constitutional measures can modify their elements, either in regard to quality or proportion; but such measures can at least influence those abnormal salivary secretions upon whose presence the caries seems, in a great degree, to depend. The mouth should be often cleansed with alkaline washes, and the brush should be used at least once or twice daily, or, as would be better still, after each meal.

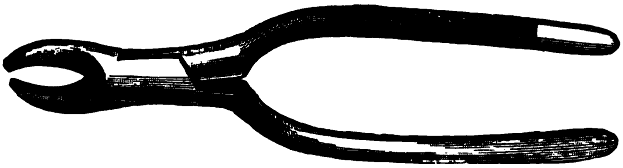
If the caries is very superficial it may be removed, and the exposed surface thoroughly polished; and if this polish is carefully maintained, the decay may not extend. If the caries has proceeded farther, it must be thoroughly removed, until sound structures are reached; and the cavity, being carefully dried, must be filled with some indestructible material. Gold-foil is the best; but platinum, tin, or lead-foil may be used. These latter are valued by dentists very nearly in the order in which they are named.

If the tooth-pulp is exposed, and it is found to be in a pretty healthy nsequence of which the teeth become loosened, and sometimes out. This happens especially in old age, when the process of expul- of the teeth is often aided, also, by hypertrophy of the cementum.

reatment.—Removal by instruments, followed by careful polishing e surfaces from which the concretion has been removed; and subently the use of the brush after each meal.

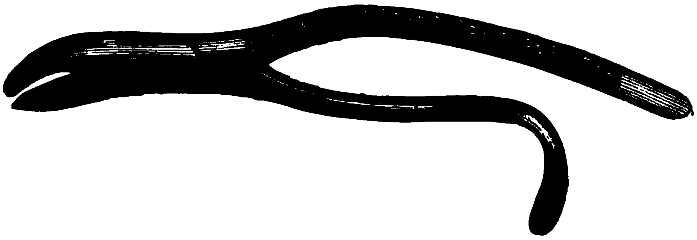
xtraction of Teeth.—In the extraction of teeth no instruments generally employed at the present day except the forceps and the tor. The "key" is now very rarely used.

Fig. 346.



Forceps for Upper Incisors, Canines, and Bicuspids.

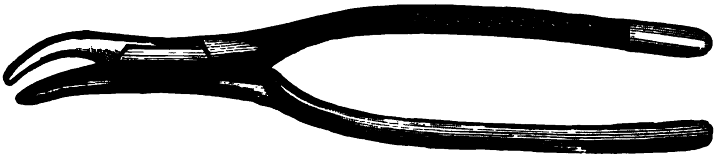
Fig. 347.



Forceps for Upper Molars.

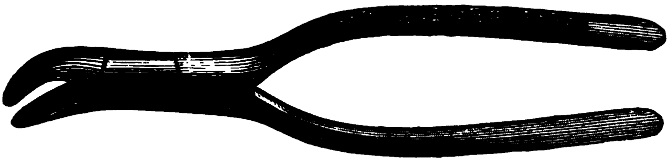
orceps are constructed of various forms and sizes to adapt them for extraction of the different teeth; indeed most dentists employ a ial instrument for almost every tooth; but in general it is sufficient e furnished with several sizes and forms of straight instruments

Fig. 348.



Forceps for Lower Incisors, Canines, and Bicuspids.

Fig. 349



Forceps for Lower Molars.

for extracting the incisors and the cuspids—indeed the same instrument will usually answer for the bicuspids also—and with two or three slightly curved instruments for the molars.

In extracting an incisor, the forceps being well crowded down upon the neck, the tooth is seized, and, with a slight rocking motion, extracted. A rotary motion facilitates the extraction of the cuspids; while a slight rocking motion, in a direction inwards and outwards, the reverse of that employed in the extraction of the incisors, enables the operator more readily to loosen and withdraw the bicuspids. The molars of the superior maxilla require an instrument having the jaws bent at a slight angle with the handles, yet they ought to be as nearly straight as the easy prehension of the teeth will permit. These teeth have three fangs, two of which are external and one internal. When the tooth is seized, therefore, it should be first rocked a little inwards and then outwards, before direct traction is commenced. The inferior molars have but two fangs, one of which is anterior to the other, and they require for their extraction, forceps having an angle of about 135 degrees with the shaft. For the extraction of stumps the levator, or forceps constructed especially for that purpose are usually employed.

Hæmorrhage after Extraction.—The extraction of a tooth has been occasionally followed by alarming, and sometimes fatal hæmorrhage. The source of the bleeding appears, in most cases, to be the alveolar periosteum, or the small branch of the inferior maxillary which supplies the interior of the tooth.

Treatment.—A small piece of lint, previously moistened with the persulphate of iron, is carried to the bottom with a firm probe. Over this a pad of dry cotton cloth may be laid, and the jaws firmly closed. If this does not succeed, I have placed between the jaws, and crowded into and around the socket, a block of gutta percha previously softened in hot water.

CHAPTER IX.

SURGERY OF THE RESPIRATORY ORGANS, IN THE REGION OF THE NECK.

Apnœa. Syn., Asphyxia, R. C.

Apnœa from Drowning.—How long a person may survive complete submersion under water cannot be definitely stated, since it must depend somewhat upon the condition of the patient, and equally, perhaps, upon the temperature of the water. Persons accustomed to diving would, no doubt, endure a prolonged suspension of respiration better than those who were not thus trained, provided, of course, they had the presence of mind to suppress inspiration. The tenacity of life is not the same in all persons: it has been affirmed, moreover, that if submersion occurs when the person is in a condition of syncope, or when the action of the heart is greatly diminished, the integrity of the brain is not so speedily compromised, since it receives less of the imperfectly oxygenated blood; but we do not know that much value ought to be attached to this opinion. It is quite certain, however, that resuscitation is more likely to take place after prolonged immersion in water of ordinary temperature, than after immersion, for the same period of time, in very cold water. We see it stated in the *Lancet*, that Dr. Richardson has shown that fish which would be presumed to be dead, from what he terms "glacial death," were easily recoverable; and that in an animal drowned in freezing water he found the temperature of the brain reduced to 56° F., while the temperature of the chest and abdomen remained at 76° F. He concludes that in these cases the apparent death, which takes place almost instantly, when a person is submerged in freezing water, is a condition of nervous shock. The heart, he remarks, "retains its power of action, the blood remains fluid, and the muscles keep up their irritability for a long time after apparent dissolution; and so favorable are all the conditions for renewal of living action, even for two hours, that a considerable advance in the practice of resuscitation must follow upon further careful and laborious experimental research." These hopeful conclusions, however, we are not prepared to accept, and only because we have hitherto no experience which would warrant their acceptance. Finally, if no water is drawn into the lungs, the chance of resuscitation is improved.

If we could trust popular opinion, and the various newspaper accounts of these accidents, resuscitation might be hoped for at any period prior to the commencement of decomposition; but the truth seems to be, unfortunately, that the complete exclusion of air from the lungs, under any circumstances, causes death in a very few minutes. It is not probable that any one has seen fit to occupy himself with noting the time by his watch while another was drowning, or has been able to observe how often he came to the surface and inhaled a little fresh air; and the occasions on which accidental coincidence of circumstances might decide the exact period of immersion must be very few. According to the experiments of a committee appointed by the Royal Medical and Chirurgical Society of London, published in 1862, dogs, whose tracheæ were closed previous to submersion, could be restored after three minutes and fifty seconds, but they were not likely to recover after four minutes and ten seconds. If, however, submersion occurred while the trachea was open and the water had free admission to the lungs, recovery never took place after one minute and thirty seconds, even when the animal was not only able to make efforts at respiration, but also to utter a cry after removal. The action of the heart continued, on the average, three minutes and fifteen seconds after the animals had ceased to make respiratory efforts, and in no case longer than four minutes. The results of these experiments cannot be applied rigorously to human beings, but the testimony which they furnish, together with much evidence supplied by experience, seems to justify the conclusion that no person can survive complete submersion longer than five minutes.

The Committee found, also, in their experiments made upon animals, that in no case did recovery take place when the action of the heart had wholly ceased. In the case of a man drowned, however, a very feeble action of the heart might exist, which could not be detected by any method of examination which could be deemed admissible.

Practically, perhaps, it is of little consequence whether a person may survive complete submersion five minutes or one hour, since it is generally impossible for us to know whether the submersion has been constant. In all cases, where there are no signs of decomposition, we believe it to be the duty of the surgeon to proceed as if it were possible to restore life; especially since his efforts can do no harm, and they will at least afford to the friends a comforting assurance that nothing has been omitted which might, under any circumstances, have resulted in restoration.

Treatment.—It might seem from what has been stated, that the first and most important indication of treatment would be the evacuation of the water which has been, in a certain proportion of cases, drawn into the bronchial tubes and air-cells of the lungs; but Mr. Harley has shown that water thus received is speedily absorbed by the pulmonic tissue, and carried into the vessels, so that it is seldom, if ever, found in the bronchial tubes. Nevertheless it will be proper in all cases to elevate the body, and lower the position of the head and neck for a moment, to insure its evacuation in case water should happen to be present in sufficient quantity to obstruct the free admission of air.

The lungs have usually suffered no actual lesion which could materially interfere with the performance of their functions. As to the water which may have been swallowed, and received into the stomach, it is harmless, and may be permitted to remain; and all that our art can propose to do is to restore circulation and nutrition, by re-establishing the actions of the heart and of the respiratory organs.

In regard to the re-establishment of respiration, it seems necessary to say, that while this indication is no doubt important, its relative value is liable to be over-estimated. It is equally important that the heart should be made to act, inasmuch as the system derives no benefit from the presence of air in the lungs until the circulation is in some measure re-established. That the expansion of the chest may have some influence in stimulating the heart to act is conceivable; but it is certain that we possess other means, whose influence upon this organ is more direct and positive, and in order to secure the best results we must at the same moment, and by the most direct methods, seek to restore the functions of both heart and lungs.

We should attempt, first, to convey air to the air-cells of the lungs by mechanical means. The simplest and most effective of all the measures hitherto practised or suggested, is to open the larynx in the crico-thyroid space, and blow directly into the lungs; or, if such an instrument is at hand, to blow through a large flexible tube, carried well down into the trachea through the opening already made in the crico-thyroid membrane. This is the method which surgeons have generally practised when patients upon the operating table have suddenly ceased to breathe, under the narcotic influence of anæsthetics, and it is the method which deserves the preference in all cases of asphyxia, from whatever cause, when the case is urgent, and when a few moments delay is likely to prove fatal.

A method which is equally effective, but not so often available, is the introduction of a tube into the larynx through the mouth and rima glottidis, and inflation, either with the aid of a pair of bellows, or through the mouth of the operator. The jaws of a person drowned are, in most cases, spasmodically closed; and it is by no means within the skill of every medical man, even after the mouth has been forcibly opened, to introduce a tube into the larynx. Nor is it often that the proper tube is at hand. If, however, it can be done, and done quickly, it must be preferred to laryngotomy.

One of the most inefficient modes, as generally practised, is to close the nostrils of the patient, and applying the mouth to the mouth of the patient, to blow forcibly. The air invariably passes through the œsophagus into the stomach; and I have seen the stomach thus inflated by a surgeon, who believed that he was inflating the lungs, Nor is it so easy as some writers seem to suppose it to be, to grasp and close the œsophagus with the thumb and fingers pressed behind the trachea. Obstetricians are very much in the habit of recommending this method of procedure with still-born children, and I will not say it may not sometimes succeed; but my experiments upon the cadaver do not justify me in according to it much value. Something more may be accomplished by this mode of inflation, if the larynx is forcibly pressed backwards against the spine; and if, while the larynx is thus pressed back, the tongue is made to fall forwards, by turning the patient over, nearly upon his face, the inflation of the lungs will often be found to be very complete.

Marshall Hall's method, which has obtained so much notoriety, and which was by him designated "The Ready Method," consists in turning the patient upon his side, a little inclined toward the back, for the purpose of causing expansion of the chest; and then rolling him quickly upon the face, in order to cause the chest to contract. While resting upon the face, the back and sides of the ribs are to be compressed with the hands. The Committee of the Royal Medical and Chirurgical Society, in their experiments upon the cadaver by this method, found that in no case was more than 10 cubic inches of air expelled, and generally a much less quantity was admitted at each succeeding expansion of the chest.

Sylvester's method consists in elevating the arms slowly from the sides until the elbows nearly touch above the head; and then bringing them again to the sides, making, at the same moment, some pressure upon the lateral walls of the chest. The Committee above referred to found that in this way the amount of air inspired varied from 9 to 44 cubic inches.

Howard, of this city, recommends that—the patient lying upon his back, while the arms are held behind the head, and the tongue is drawn out—both direct and intermitting pressure shall be made upon the anterior margins of the false ribs, by the palms of the hands. This is to be accomplished in the following manner:—The operator kneeling, with his legs astride the patient's abdomen, and with his elbows braced against his sides, throws himself forwards, thus re-enforcing his hands by the weight of his body. The air, being expelled, is allowed to re-enter by removal of the pressure, and the consequent return of the ribs to their former positions.

In all of these methods an attempt is made to imitate the natural act of respiration, by expanding and contracting the chest about fifteen times in the minute.

Of these several modes of procedure it is quite certain that Marshall Hall's is the least efficient. Between Sylvester's and Howard's there is perhaps very little to choose; they are both simple, and capable of causing a considerable change of air within the bronchial tubes, and, perhaps, of effecting some interchange within the air-cells themselves. It is possible, however, to do more than either of these methods can accomplish, by elevating the body to a sitting posture after each expiratory manœuvre (or to a more or less erect posture, the body being lashed to a board); in which position, the weight of the liver and of the other abdominal viscera will cause the diaphragm to descend, and thus compel the admission of air to the lungs. When the body is again made to assume the recumbent posture, and especially if the head and chest are allowed to fall lower than the hips, the viscera of the abdomen will crowd upon the diaphragm and expel the air with considerable force. There will be no difficulty in combining with this procedure both Sylvester's and Howard's methods, if while lifting the body the arms are elevated above the head, as practised by both Sylvester and Howard; and if, when the body is again placed in the recumbent posture, the anterior and lower portions of the thorax are compressed forcibly, as recommended also by Howard.

Electricity, and sharp, quick strokes with the palm of the hand upon the thoracic walls, may possibly arouse the muscles of respiration; but it is frivolous to sprinkle or to dash cold water upon a nearly inanimate body. Whenever it is attempted to cause inspiration while the body reposes upon the back, the tongue must be held forwards, to prevent its pressure upon and closure of the glottis.

The measures which can be rationally suggested to renew or to increase the action of the heart must also, in some measure, tend to influence respiration. Caloric, and electricity, are perhaps the only agents which can be made to penetrate to those deeper central organs in which the few remaining sparks of life now linger. Embrocations of brandy, whiskey, or alcohol are useless; and so also are frictions, and even vesicants, unless they convey caloric. If so much sensation remains in the periphery of the body as to cause a response to these agents alone, it is quite certain that nature, unaided, is competent to the restoration. With all diligence the body should be made warm with blankets, hot bricks, bottles, sand-bags, or whatever else may be available. A current of electricity, conveyed directly through the heart, is of all means that which would promise the most, but the apparatus required for its application is seldom at hand. In a few instances of asphyxia from drowning, and from other causes, it has been employed with success. Succussion, sometimes of value in exciting respiration, may be equally serviceable in arousing the action of the heart. So also the agitation of the heart, in rolling the patient from side to side, according to Marshall Hall's method, may have accomplished more toward the restoration of life than the inconsiderable change of air in the lungs which this process causes. In this regard, too, our own method of encouraging respiration has eminently the advantage over either of the others.

I shall not venture to recommend venesection as a remedy for asphyxia, for the reason that there seems at present to be among intelligent medical men a distrust of its efficacy, and because I have no personal experience and know of no recorded observations in relation to its employment. At one time, however, it was in high repute with our profession; and there seems much plausibility in the theory upon which the practice was defended, namely, that inasmuch as the right side of the heart, and the venous system generally, are in these cases found after death filled with blood, the stagnation might be relieved and the circulation re-established by unloading the veins.

There are many other ways in which the trachea may become obstructed, causing suffocation; a few of which it will be necessary to mention, as demanding certain modifications in the plan of treatment.

Apnœa from Hanging.—In legal executions, where the person is permitted to fall from a height, the processus dentatus is often broken, or its ligaments ruptured, causing instant death by the pressure of the displaced vertebræ; but in suicidal hanging death is sometimes caused by congestion of the brain, consequent upon an interruption of the venous circulation, and then it takes place more slowly. In a large majority of cases, however, death by hanging is from suffocation, and differs from the suffocation caused by drowning only in the fact that no water is admitted to the lungs. It will be remembered that the experiments of the Committee to which reference has already been made, established the fact that the admission of water hastened the fatal result. Death from suffocation caused by hanging is not, therefore, in general, so speedy as death from drowning.

Treatment.—Laryngotomy, with a view to the inflation of the lungs, is the most trustworthy expedient. If, however, for any reason, this is not practicable, or may not seem advisable, any of the other methods recommended for the re-establishment of respiration in cases of drowning will be appropriate.

Apnœa from the Presence of Foreign Bodies in the Air-Passages.—When a foreign body has entered the air-passages it may lodge in the ventricles of the larynx; it may descend and be arrested at the bifurcation of the trachea; or, finally, it may be admitted into either one of the bronchial tubes.

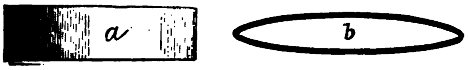
In case it has lodged in the ventricles of the larynx, its presence is indicated by paroxysms of cough and of suffocation, alternating often with considerable periods of rest, and so complete as to encourage a hope that it has escaped. In other cases the dyspnœa is constant, although variable in intensity. The patient is sometimes able himself to indicate where it is lodged; or its presence is recognized by a whistling or rushing sound, sufficiently audible to the unaided ear, but more readily detected by the stethoscope. The voice is usually, in these cases, reduced to a whisper, or it is broken and husky.

When a foreign body has passed below the inferior cordæ vocales, and has been arrested at the bifurcation, it seldom remains fixed in one position, but is carried up and down by each act of expiration and inspiration; and especially is it liable to be thrown with violence against the vocal cords in a paroxysm of coughing, closing the air-passage completely, and threatening instant suffocation. Sometimes, by the aid of the stethoscope, it may be heard striking against the vocal cords and the bifurcation of the trachea.

In the bronchial tubes, again, substances inhaled are apt to become arrested and impacted, causing, in a few examples, very little impediment to respiration; but, in most cases, giving rise to a harassing cough, and to serious pulmonic lesions, and finally causing death unless they are extricated.

Treatment.—Examples of spontaneous expulsion of foreign bodies drawn into the air-passages are not unfrequent. The two following cases came under my own observation:—A man was ill of what was supposed to be tuberculosis. Two weeks before his death he coughed up a pea, which was exceedingly hard. He had no knowledge of how it got into his lungs, but he remembered eating a dish of peas about one year before, and his cough commenced about the same time. A boy fourteen years of age, residing in Arundel, N. Y., inhaled, while running, a tin whistle formed of two pieces of tin, each about one inch in length by one-quarter of an inch in breadth, slightly bent upon their long axes, and fastened together by narrow silk tape and thread. The accompanying wood-cuts give an accurate representation of the whistle, the silk tape and thread being omitted. (*a*, side view; *b*, front view.) I saw him on the fifth day after the accident. No air was then admitted into the left lung, except immediately after coughing, when a rushing sound was heard. He had some cough, and the sputum was occasionally streaked with blood. There was some pain in the larynx, but none in the left bronchus, where the foreign body was lodged. Most of the time he breathed without any sense of discomfort, and he was going about entertaining himself as usual. Knowing that the whistle was impacted in the bronchus, and having very little reason to suppose that it could be reached and dislodged by a probe, I declined to operate, preferring to trust him to the resources of nature. Three months later, while rolling some sacks of wool, the whistle became loosened, and was thrown up to the larynx, but immediately fell back and remained in its old position. The following week, while making some unusual exertion, it came up again, and was at once expelled through the mouth, having remained in the lungs one hundred and four days. The boy soon recovered his health completely, but after the lapse of several months, in consequence of exposure to cold, he was attacked with acute laryngitis and died.

Fig. 350.



Tin whistle inhaled, and spontaneously expelled.

Dr. Gross, in his treatise on Foreign Bodies in the Air-Passages, has collated a large number of similar cases of spontaneous expulsion; 49 of which recovered; while the number reported as having died after spontaneous expulsion is only 8. We must not forget, however, that the latter class of cases is always least apt to find its way into the published records, since those cases in which the patients die without expulsion of the foreign body, and without operations, reflect too often upon the judgment of the surgeon who has permitted these substances to remain, to warrant a hope that they will be faithfully recorded.

The fact is, that the occasional fortunate results of non-interference will not, save in a few exceptional cases, justify the omission to employ all the therapeutical and surgical means we possess for their speedy removal. So long as they remain, the patient is liable at any moment to perish suddenly from suffocation, and he is in imminent danger from the various pathological lesions which are likely to ensue.

If the body inhaled is round, smooth, and especially if it is heavy—as for example a shot or a bullet—it will be proper to hold the patient up by his feet, or to lay him upon an inclined plane with his head lower than his body, and to strike briskly upon the back. Yet in no case is aryteno-epiglottidean folds—may, in some cases, be relieved by free scarification of these folds.

Scarification is best accomplished by the use of a knife slightly curved, and having an oval cutting extremity; and the operation will be facilitated by drawing out the tongue slightly, so as to bring the œdematous tissues more distinctly into view. If, on account of the exquisite tenderness and sensibility of the parts, it is impracticable to open the mouth sufficiently, or to draw out the tongue, and the seat of the œdema cannot be seen, the knife may possibly be introduced and the incisions made under the guidance of the index-finger of the opposite hand.

Scarification, by the method and with the instrument above described—first suggested and practised by Gurdon Buck of this city[1]—is far more effective than the slight punctures recommended by Lisfranc. Relief by means of laryngeal scarifications is, however, always very uncertain, and whenever the symptoms are urgent, or scarification has failed to diminish the œdema, laryngotomy ought promptly to be undertaken. Indeed it is probable that if surgeons would trust less to scarifications and more to the speedy opening of the windpipe, the results of these cases would prove more fortunate than they have hitherto; since, according to the most reliable statistics, more than ninety per cent. have died. It is proper to state, however, that of eleven patients operated upon by Dr. Buck's method, and collated by him, all are said to have recovered.

Abscess of the Larynx, as a result of acute laryngitis, has been more often recognized as the cause of apnœa since the introduction of the laryngoscope. The abscess forms beneath the mucous membrane, usually above the vocal cords, and in most cases terminates in spontaneous evacuation and recovery. Its rupture has sometimes been effected by the action of an emetic; but it may become necessary, when suffocation is impending, to open it with the knife.

Senile ossification and necrosis of the arytenoid cartilages gave rise to an abscess, which eventually caused death, in an old lady, 77 years of age, who was under my observation. I relieved her from impending suffocation by tracheotomy, which operation she survived thirteen days. In other examples reported, *perichondritis* has resulted in certain pathological changes of the arytenoid, cricoid, and other laryngeal cartilages, accompanied with the formation of intra-laryngeal abscesses.

Intra-laryngeal Growths.—According to Tobold, neoplasms occur in the larynx, arranged in the order of their frequency, as follows: *Fibrous polypi*, arising from the connective tissue; *papillary tumors*, or examples of hypertrophy of the papillary bodies; *epithelial and*

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[1] **Œdematous Larynx,** by Gurdon Buck, Jr., M.D., with Illustrations. *Trans. Amer. Med. Assoc.*, vol. 1, p. 135. Also vol. 4, p. 277.

medullary growths; mucous or cystic polypi; and *lipomatous or fatty tumors.*

The symptoms which indicate their existence will depend very much upon their nature, size, and situation. The malignant forms are confined chiefly to advanced life, but the benign intra-laryngeal growths are more common in middle and early life. The progress of the latter is sometimes very slow, and they may exist a long time, or even through the whole course of life, without causing great inconvenience.

Treatment.—With the aid of the laryngoscope and properly constructed forceps, scissors and knives, small tumors, situated above or upon the vocal cords, may be removed through the mouth. If situated lower down, laryngotomy or tracheotomy will be required, or perhaps the operation termed thyrotomy.

In 1866, Dr. Watson made the operation of *excision of the larynx,* including one ring of the trachea, for syphilitic ulceration of the larynx. His patient died. Since that time, according to the enumeration made by Drs. Baum and Mackenzie, 36 entire and 6 cases of partial resection have been reported as having been made for epithelioma, carcinoma, sarcoma, fibroma, enchondroma, stenosis, and necrosis; a majority being made for epithelioma.

Of the 36 complete excisions 6 are reported as "recovered." 3 of these latter were examples of sarcoma, or of sarcoma with papilloma, and 3 of carcinoma. One of the cases of sarcoma was living after six years. None of the other cases are known to have survived beyond nine months, and most of them died very soon after the operation. The 6 reported examples of partial excision do not supply any better results.

Since the date of the statistical enumeration above-given—1885—at least one successful removal of the entire larynx has been published.

Roswell Park, M.D., Professor of Surgery in the Buffalo Medical College, removed June 28, 1885, from a man somewhat advanced in years, the entire larynx, with the first ring of the trachea and the uvula, which latter was found to be slightly involved. The upper part of the epiglottis, with its glossal and lateral connections, were left *in situ.* The disease, an epithelioma, caused by the excessive use of tobacco, had been developing slowly during many years. Tracheotomy had been performed some months before, but the progress of the disease so interfered with the admission of air by the tracheotomy tube that at the time of the operation of excision, death from suffocation seemed to be impending.

In three weeks the patient rode a mile. In twenty-four days the œsophageal feeding tube was introduced through the mouth, instead of the wound, which was no longer sufficiently open. In five weeks he was wearing the pharyngeal portion of Gussenbauer's artificial larynx. In seven weeks he was able to swallow soft solids, and the obturator of the tube was introduced. In eight weeks he was able, by means of the vibrating reed, and the addition of the tracheal connections of the instrument, to articulate distinctly and in a loud tone. By a process of self-education he was soon able to swallow food and drinks to a certain extent, even without the aid of the obturator, having acquired the power of protecting the open upper end of the pharyngeal tube by that portion of the epiglottis which remained. This was the patient's condition when, fourteen weeks after the operation, he was brought before the medical class, wearing the Gussenbauer instrument introduced through a small fistulous opening in the front of the neck. There was no appearance of a return of the malady.

Considering the record of this operation as thus furnished, including the few temporarily successful cases, especially that of Park, I cannot but think that it can be seldom justifiable, since the vast majority of cases demanding excision are of a malignant character, and the disease is almost certain sooner or later to return. Certainly in most cases thyrotomy, or tracheotomy must claim the precedence.

Membranous Croup and Diphtheria.—That surgical interference is proper in certain cases of membranous croup and of diphtheria, no longer admits of a doubt, but precisely under what circumstances an operation is justifiable or demanded, it may not be so easy to decide. In the case of a mere mechanical obstruction of the air-passages, or in case, even, of a distinctly localized pathological lesion and consequent obstruction, the question as to the propriety of an operation is relatively very simple; but in membranous croup and in diphtheria, especially in the latter case, the elements which must enter into the estimate are numerous, and the solution of the problem is often exceedingly difficult.

The laryngeal obstruction occurring in connection with diphtheria is but a local manifestation of a general malady, indicating a peculiar septic condition of the blood, against which the patient must struggle, and probably ineffectually, even when air is admitted freely. Membranous croup is also, it is believed, a sign of blood-poisoning, less intense, perhaps, than exists in diphtheria, but no less pervading, and liable to cause death independent of the local obstruction. In both, the lungs are often early and hopelessly involved. Moreover, in such conditions of general dyscrasy the operation itself causes more local disturbance, and reflects more injury upon the general system, than does the same operation made upon healthy structures, with a sound condition of the body. In other words, the perils incident to the infliction of wounds in the air-passages, to the introduction and maintenance of tubes, and to final cicatrization, which in any case are worthy of being reckoned, are in these cases greatly increased.

As to the value of statistics, as aids in the solution of these questions, the most that can be said is, that they may have determined the propriety of the operations reported; but they are seldom or never presented in such rigorously classified groups, as would enable us to apply their conclusions with any degree of precision to the case under observation. Besides, quite often, when obtained from sources apparently equally reliable, they show entirely opposite results.

From 1850 to 1854, inclusive, M. Trousseau had operated in the Hoseck is so exceedingly short and fat, or swollen, as to render the oper- tion impracticable. In the case of adults, laryngotomy may generally e chosen.

Laryngotomy.

In both laryngotomy and tracheotomy anæsthetics give us invaluable id, and chloroform is to be preferred. The instruments required are nives, forceps, laryngotomy tubes, with blunt and sharp hooks. Laryn- otomy tubes may be constructed in all regards like tracheotomy tubes, nly that, as the opening through the cricoid cartilage is greater in its ansverse than in its antero-posterior diameter, the tube should be flat- ned antero-posteriorly. It must be smaller than the tube employed fter tracheotomy, in persons of the same age. The surgeon should e also well provided with short, firm, but flexible probangs, armed ith bits of soft sponge, for the purpose of cleaning the wound and e tubes.

The patient, thoroughly anæsthetized, is placed supine, with his oulders elevated and his head thrown back; and while an assistant eadies the head, with the face directed upwards, the surgeon makes n incision in the median line, extending from the top of the thyroid rtilage to the lower margin of the cricoid, about one inch or more in ngth, making his way between the sterno-thyroid muscles down to the ico-thyroid ligament. During this part of the operation he may have ounded the crico-thyroid (inferior laryngeal) artery, and a loop of the perior thyroid vein, both of which will usually require the ligature, in se they are cut; at least it will not be proper to open the larynx until ll bleeding has ceased. The surgeon should be careful also, before cising the membrane, to expose it freely, by pushing the superincum- ent tissues well to each side, in order that when the transverse incision made through the membrane, there may be no risk of incising ther small vessels. The membrane is now cut through its entire length, ertically, and the opening enlarged by slight transverse incisions. mmediately after the opening is made, if the patient is not under the fluence of an anæsthetic, the face assumes an expression of intense larm; and I have observed a change in the features—an additional allor, usually—even when the patient is completely anæsthetized; at e same time the breathing becomes irregular and agitated. It is well wait a moment, after making the incision, for the respirations to be- me more regular and composed, meanwhile holding the edges of the cision apart with blunt curved hooks. If, as sometimes happens, spiration ceases momentarily after the opening is made, the feather d of a goose-quill, thrust down the trachea, will excite the muscles of spiration to reflex action. A bent probe may accomplish the same urpose. When respiration becomes established and composed, the tube carefully introduced, and retained in place by tapes fastened in the es of the outer canula and tied loosely behind the neck.

A competent assistant must remain with the patient when the surgeon leaves, instructed to remove the inner tube occasionally, cleanse it with hot water and a sponge, and return it. As often as once in twenty-four hours, also, it generally becomes necessary to remove the whole instrument, that is, both the inner and the outer tubes; when the patient will force out more or less mucus, pus, and membranous exudation which, while the instrument was in position, had not been permitted to escape. Its re-introduction is often difficult, and demands usually an amount of coolness, decision, and practice, such as the assistant is not likely to possess; and for this reason both the removal and the replacement should be effected by the surgeon himself. In most instances, if the progress of the case is favorable, the tube may be removed finally on the fifth or sixth day, and the opening then be permitted to close gradually and without assistance.

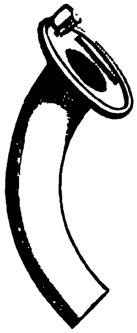
Tracheotomy.

Tracheotomy below the Thyroid Gland.—In this operation the superficial incision should commence in the median line, about opposite the lower margin of the cricoid cartilage, and extend nearly as low as the top of the sternum, dividing the tissues, as the depth of the wound is increased, between the sterno-thyroid muscles; the incision being limited above by the lower border of the isthmus of the thyroid gland. The utmost care must be exercised not to wound, unnecessarily, the plexus of thyroid veins which lie across the track of the incision, both superficially and deep. This may be accomplished by using blunt instruments, such as have been described and illustrated at p. 211. The handle of a knife or straight steel director may answer, but they constitute imperfect substitutes. The surgeon who has never adopted this method in prosecuting dissections among deep and swollen tissues, such as we often meet in this operation, and where veins abound of whose anatomical relations we cannot be assured, scarcely knows how to appreciate its advantages. The dissection may in this manner be made rapidly, and the trachea may be reached through a comparatively dry wound. Some of these veins lie close upon the trachea, and I have myself, in one case, had a profuse hæmorrhage caused by the accidental section of one of them, at the very moment that I was cutting the rings of the trachea. To avoid such an accident, the trachea should be well exposed, so as to be seen distinctly divested of all of its coverings before it is opened. Small arterial branches may also be divided, and the surgeon will not forget the relations of the primitive carotids to the trachea, and that the left vena innominata crosses this tube opposite the episternal notch. The depth at which the trachea lies below the surface of the integument is seldom less than one inch, generally it is much deeper, and I have operated once when it was full two inches and a half.

In opening the trachea it should be steadied between the thumb and finger, or seized with a pair of toothed forceps, or a well-curved hook, while the point of the knife entering at the lower angle of the wound is thrust in and made to cut upwards, dividing three of the cartilaginous rings. Having waited a few seconds, or minutes, while the lips of the tracheal tube are held asunder by blunt hooks, as already directed in cases of laryngotomy, the tube may be introduced. It is generally more difficult to introduce the tube in tracheotomy than in laryngotomy, on account of the firmness of the cartilages, the tube being too large to gain admission unless the tracheal wound is held well open. For this reason some have advised resection of a small portion of one of the rings, but, with attention to the instructions here given, this will be found unnecessary. A conical tube will be introduced more easily, and on the first occasion of its removal it may be replaced by a tube of cylindrical form. It may be well, also, to have at hand Fuller's bivalve tube, which in case of difficulty might be preferred.

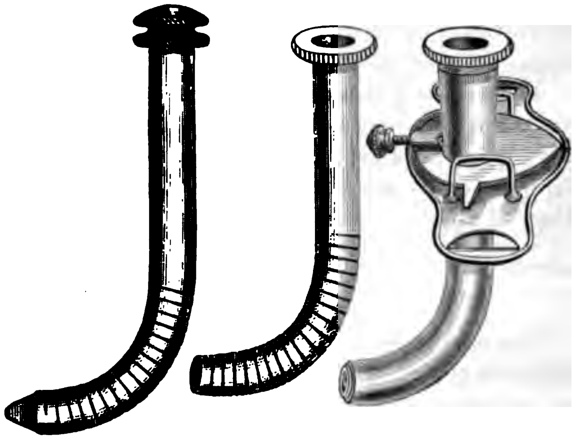
I have recently received from Mr. Stollman, instrument-maker of this city, a double tracheotomy tube, constructed with an especial view to facilitate the introduction, and with various other points of excellence which commend it to the practical surgeon. It is a modification of the instrument invented by Mr. Durham, of England. The instrument consists of an outer tube, which is intended to pass straight back into the trachea, and then to turn downwards in such a way that its extremity shall occupy the middle of the trachea, and its edges shall not unduly press against the lining membrane. The straight portion of the tube slides backwards and forwards in a collar, but can be fixed at any point by means of a screw. The portion of the tube in the wound may thus be regulated in length according to the depth at which the trachea is situated. The inner tube is rendered flexible by a construc-

Fig. 351.



Cylindrical Tracheotomy Tube.

Fig. 352.



Durham's Tracheotomy Tube, modified by Mr. Stollman.

Vandeventer, Treadwell, and Bogart—the child being under the influence of chloroform—I opened the larynx in the crico-thyroid space, when the tumor immediatly presented itself at the point of incision, but the space proved to be insufficient to permit of its removal; I proceeded, therefore, at once to enlarge the opening, by cutting directly upwards through the thyroid cartilage, being careful to keep the knife precisely in the median line. Drawing the alæ of the cartilage apart with blunt hooks, the whole interior of the larynx was brought into view, and the neoplasm was found situated between the vocal cords, being attached at or near their posterior extremities. With a pair of delicate forceps it was easily removed; and to the lacerated surface left, a small quantity of chromic acid was applied by means of a blunt piece of soft wood. It was now observed that the crico-thyroid space was too small to permit the introduction of the laryngeal canula without causing the wings of the thyroid cartilage to separate, and the incision was enlarged in the direction downwards, through the cricoid cartilage; the tube was then introduced readily. During the two subsequent years this child wore the laryngeal tube constantly, enjoying excellent health and spirits. So far as I can learn, the papilloma did not return; but he died at about the end of the second year, of an acute attack of laryngitis.

Kirshaber has made a similar operation for the removal of an intra-laryngeal neoplasm, differing only in this regard from the operation above described, that the incision was limited to the thyroid cartilage. I doubt, however, whether it will be found practicable, except by the application of very considerable force, to separate the alæ sufficiently to examine well the interior of the larynx, or to remove a morbid growth therefrom, without cutting, also, either the crico-thyroid or the thyro-hyoid ligaments.

Dr. C. C. Terry, of this city, has suggested that in making the operation of thyrotomy, in case the incisions were to be limited to the thyroid cartilage, a curved, sharp-pointed knife might be introduced at the upper margin, with its point directed rather downwards than upwards—lest it enter the loose areolar tissue under the epiglottis—and carried carefully downwards until the separation is completed.

Appreciation and Application of the various Incisions upon the Larynx and Trachea.

Laryngotomy, practised at the crico-thyroid space, is preferable in all cases of apnœa from drowning, from the inhalation of mephitic gas, hanging, œdema glottidis, abscess, and ulcerations of the larynx, in most cases of intra-laryngeal growths, and whenever foreign bodies are lodged in the ventricles.

Thyrotomy, with or without incision of the crico-thyroid ligament, may be substituted for laryngotomy, so called, in certain cases of intra-laryngeal growths, when, in the opinion of the surgeon, it would be fficult to remove these formations safely and thoroughly without hav ıg at the moment a perfect view of their attachments.

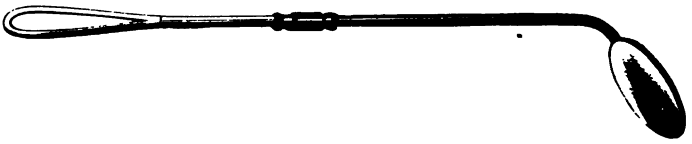
Tracheotomy above the isthmus of the thyroid gland is to be preferred in all cases of diphtheria and of croup, when the gland is not in a condition of hypertrophy. Tracheotomy below the isthmus will be reserved, therefore, for those rare examples of diphtheria or croup accompanied with hypertrophy of the thyroid gland, and for those equally rare examples in which the surgeon undertakes the removal of foreign bodies impacted in either the right or left bronchus.

Laryngoscopy.

The employment of reflectors for the purpose of inspecting the interior of the mouth, and even the glottis, dates as far back as the middle of the last century; but no considerable progress was made in the construction and application of the instruments, until, in 1829, Babbington, of London, invented what he termed the "glottoscope." Türck, in 1857, began zealously to experiment with the laryngeal mirror, using, however, only solar light. Soon after, Czermak substituted artificial for sunlight, and from this period laryngoscopy must date its most brilliant successes.

For ordinary purposes I employ glass mirrors, very much like those employed by dentists; the mirrors being made of various sizes and forms to adapt them to different throats, their diameter ranging from half an inch to one inch and a quarter.

Fig. 353.

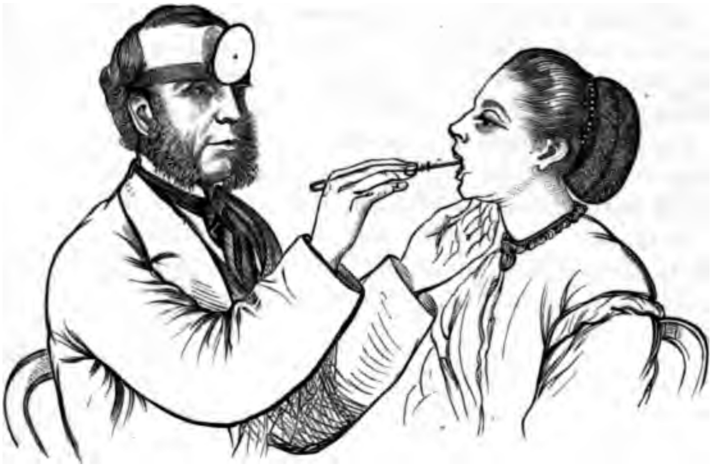


Laryngeal Mirror.

The patient, facing a strong sunlight, opens his mouth widely, while the surgeon introduces the mirror, previously warmed, lifting the uvula gently with the back of the instrument, when the epiglottis will be seen reflected from the mirror, and occasionally the glottis also will be brought distinctly into view. Ordinarily, however, the glottis cannot be seen until the epiglottis is lifted, by drawing forward the tongue; which the patient may do himself, by seizing it with a towel between his thumb and fingers. If now the patient makes a full inspiration, the epiglottis will be lifted more completely, and the cordæ vocales will separate, and may be seen in motion. They may also be seen, and observed to vibrate during expiration, while uttering the simple sound "ah."

In addition to the mirror, employed as above described, which can y be used where there is a strong direct light, the surgeon may place fore his eye, or attach to his forehead by means of a strap, a reflector,

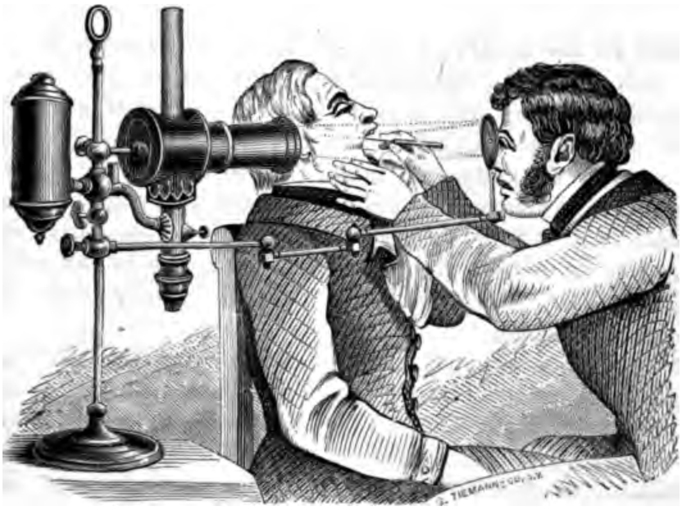
Fig. 354.



Laryngoscope with Mirror and Reflector.

order to concentrate the rays upon the back of the mouth. This may used with sun or artificial light. It is with the instrument thus con-

Fig. 355.



Laryngoscope employed with Artificial Light.

ted, in the hands of persons accustomed to its use, that we are able tain the most satisfactory results. First, there may be seen the of the tongue, the tip of the epiglottis, and the intermediate fossa.

of the operator has more experience in the use of the instrument, by the exercise of skill and patience, he will be able to recognize distinctly the arytenoid cartilages; the aryteno-epiglottidean folds; the ventricular bands, called also the superior or false vocal cords; the inferior or true vocal cords, which are of a pearly-white or gray color, contrasting strongly with the pink and yellow colors of the other portions hitherto brought into view, and which appear in a state of constant vibration, separating also in inspiration and becoming partially closed in expiration. During prolonged inspiration, in many persons, more or less of the rings of the trachea may be seen, including the cricoid cartilage. They will be recognized as white circular lines, with rings of a pinkish color interposed. Occasionally, also, the bifurcation of the trachea is visible, appearing as two indistinct dark circular spots, separated by the point of bifurcation, which reflects the light.

CHAPTER X.

SURGERY OF THE PHARYNX AND ŒSOPHAGUS.

Tumors in the Pharynx are rare, and such as occur are usually fibrous, fibrocellular, or fatty, and often pediculated.

Pediculated tumors may be removed by the écraseur or by the ligature. In some cases they have been cut away with scissors. Tumors having a broad base, attached either to the walls of the pharynx or œsophagus, can scarcely be considered amenable to surgical treatment. In the case of an elastic tumor having a very broad base, attached to the posterior wall of the pharynx, presented recently at Bellevue Hospital, my colleague, Dr. Alexander Mott, tied both carotids, with, however, only temporary benefit.

If the tumor is situated low in the pharynx, the application of the écraseur is apt to occasion spasm and closure of the glottis. To avoid the danger of suffocation from this cause, laryngotomy might be first performed, and free respiration insured by the presence of a tube.

Dilatation of the Pharynx.—It has occasionally been observed that the pharynx has become dilated upon one side, forming a pouch in which the food is apt to lodge, so as to require pressure upon the side of the neck for its dislodgement. Sometimes the dilatation involves the entire parietes of the pharynx. Still more rarely similar changes have been observed in the œsophagus.

Contraction of the Œsophagus.—Contraction or stricture of the œsophagus may be spasmodic or permanent.

Spasmodic contractions of the œsophagus occur in hysteria and in various other conditions of the system, especially in women. Their long-continued and frequent recurrence probably leads, in some cases, to the formation of a permanent stricture. The treatment is wholly therapeutical, and consists in the employment of assafœtida, musk, camphor, chloroform, and other antispasmodics internally, with the simultaneous adoption of such means as may improve the general health.

Permanent strictures and *occlusion* are caused by the swallowing of hot and caustic fluids, by wounds, and the growth of tumors, especially of carcinoma. The last occurs almost exclusively in advanced life. The most usual seat of all the forms of stricture is opposite or just below the cricoid cartilage, where the passage is naturally more contracted than elsewhere. Obstructions at the cardiac orifice of the stomach are, also, not very unfrequent. (See Gastrotomy.)

Stricture from the presence of carcinoma can only be alleviated by the occasional careful introduction of soft and flexible bougies, and finally by the introduction of a tube for the purpose of conveying nourishment into the stomach. Whenever this is impracticable, the life of the sufferer may still be prolonged a few days by nourishing enemata. These should be repeated every four or six hours, and the pangs of hunger may be at the same time allayed by adding to the enema twenty or thirty drops of laudanum.

Stricture from other causes seldom terminates in complete occlusion; but it is rarely cured when it depends upon organic changes of structure. In a few cases some improvement attends the frequent introduction of gum-elastic bougies, provided always they are introduced cautiously and without the employment of force. In several instances upon record the attempt to introduce bougies forcibly has caused laceration of the œsophagus, and fatal abscesses have ensued.

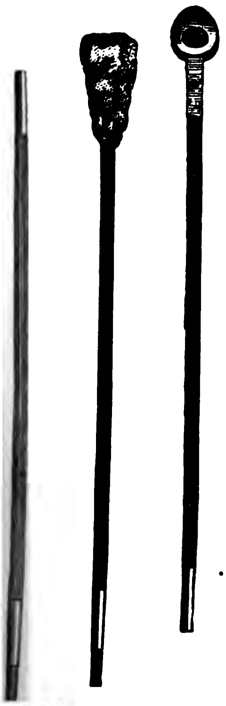
Foreign Bodies in the Pharynx or Œsophagus.—Fish-bones, pins, needles, a crust of bread, solid pieces of meat, and various other substances are occasionally arrested in the pharynx, causing more or less annoyance, with difficulty of deglutition or of respiration, but very seldom causing death.

First, we frequently meet with cases in which sharp, angular crusts of bread, fish-bones, or pins have become lodged between the base of the tongue and the epiglottis, causing incessant cough and apprehension of suffocation. If the mouth can be opened widely, this point may be reached with the finger, and the body dislodged with the nail; or the tongue may be drawn out of the mouth, and with a pair of curved forceps it may be seized and extracted.

Second: small, angular, or pointed bodies often lodge between the anterior and posterior pillars of the fauces, in the neighborhood of the tonsils, causing a sensation of pain during every attempt at deglutition.

threatened with suffocation. It may be proper, in the first instance, to endeavor to reach the body by the finger, by which means in a few cases it may be loosened, and thrown out by the spontaneous efforts of the patient. In most cases, however, it is beyond the reach of the fingers, but even then the effort to vomit, excited by the presence of the finger, will sometimes cause its expulsion. Failing in this, if it be an angular body, I have succeeded with an instrument—the œsophageal snare—armed with loops of strong silk thread, which, after introduction, should be turned two or three times upon itself, so that, if possible, the body may be entangled and brought out. The next expedient most worthy of a trial is the employment of an instrument, invented many years ago, and which I call the "umbrella probang." It is composed of an India-rubber tube, enclosing a whalebone shaft, which latter is terminated below by a very small ivory bulb. The lower end of the tube is united to the lower portion of the shaft by a number of hog's bristles, arranged longitudinally, and forming a complete investment of the shaft over a space of two inches. The instrument is introduced with the tube withdrawn upon the shaft, as far as the length of the bristles will permit. When the end of the instrument has reached the bottom of the pharynx, the tube is slid forward upon the shaft, and the bristles are made to open in the form of an umbrella; it is then turned upon itself and withdrawn.

Fig. 358.

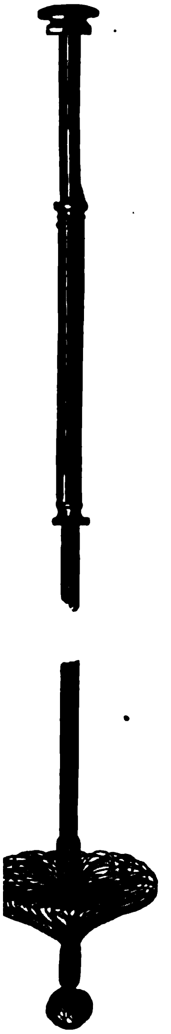


Jointed Œsophageal Sponge Bougie and Button-hook.

Long, curved forceps, and bougies armed with floating, button-like hooks, may sometimes be used with success.

If a solid piece of meat has become impacted in the pharynx, life is even more endangered than when angular bodies are lodged, since they occasion not only a spasm of the glottis, but by their bulk they displace the arytenoid cartilages and cause them to encroach upon the laryngeal space. Several cases of sudden death from this cause have been reported; and many years since I made an autopsy of a man and removed from his pharynx a large piece of tough boiled beef, which had caused his death almost instantly. In the act of death it had been grasped so firmly by the pharyngeal muscles that it required great force to remove it by the aid of a strong hook. In such a case, an attempt ought to be made to induce vomiting, or to extract the piece of meat by thrusting the fingers or as much of the hand as possible into the pharynx; or, in case a blunt hook is at hand, it might be employed. If suffocation is imminent, the larynx must be at once opened. The misfortune is, however, with ionally they may be seen by the aid of a good light. They are s within reach of the finger, and may be dislodged by the nail if eeply embedded.

Fig. 356.

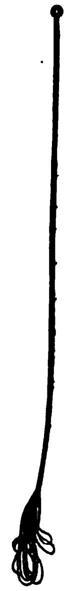


rella Probang.

rd and more frequently, pins and fish-bones are caught in the walls pharynx, back of the posterior pillars, in the lateral pouches situ- etween the cornua of the hyoid bone and the wings of the thyroid ge, causing pain in deglutition, and sometimes embarrassment to respiration. They cannot usually be seen nor often felt distinctly, but the patient will indicate their seat by placing his finger upon a corresponding point on the outside of his neck.

In this situation they may occasionally be reached and dislodged by the finger, but I could never succeed with forceps. An emetic will sometimes dislodge them; but, in most cases, I have advised these patients to let them alone after I had failed with the finger, assuring them that they would, in all probability, soon become loosened by ulceration, and escape. Occasionally, however, we meet with exceptions to the general rule; the foreign body making its way safely through the tissues to the external surface. In one case a fish-bone penetrated the side of the neck, forming an abscess, and was removed by myself through an external incision. In a second example, a needle penetrated the neck from the pharynx, and I removed it some weeks later from the front of the neck, where its point had formed a small pustule. While searching in the pharynx, care must be taken not to mistake the hyoid bone for a foreign body, as happened once in a case which subsequently came under my own observation; the surgeon having seized the hyoid bone with his forceps and made vigorous attempts to pull it out.

Fig. 357.



Œsophageal Snare.

Fourth: angular bodies and solid pieces of meat become lodged occasionally in the lower part of the pharynx, and, pressing forward upon the larynx, the rima glottidis to close spasmodically. Under these circum- s the patient is usually in a condition of great alarm, feeling ntly some impediment in breathing, and at intervals being which he swallowed when eight years old, and which passed his bowels safely on the third day.

Sixth: angular bodies lodged in the œsophagus, in a large proportion of cases, when not interfered with, sooner or later become loosened, probably by ulceration, and are either thrown up, or carried into the stomach, making their way after a time through the rectum. Such accidents are, however, by no means free from danger, since in exceptional cases they perforate the tube, and in one way or another prove fatal. It is always proper, therefore, to make every reasonable attempt to remove them. Forceps are in these cases of no use; but I wish especially to warn the profession against the employment of inflexible hooks, such as are frequently attached to œsophageal probangs. In one case, where a fish-bone was lodged in the œsophagus, the hook became entangled either in the bone or some of the cartilages of the trachea or larynx, and although I turned it and pushed it down repeatedly, it was only withdrawn at last by force, which lacerated the tissues severely. In a second case I employed the "button" instrument with a like result, my patient falling upon the floor in a condition of partial asphyxia before the instrument could be withdrawn; and it was only extricated at last by sliding over it down to the button a section of a stomach-tube.

In these cases the instruments before described, so constructed as to expand like an umbrella, or loops of thread attached to a flexible rod, are much better, and completely safe. A sponge probang may also be employed, being introduced compressed and dry, but partly covered with a little melted tallow; after introduction it must be soaked and expanded by allowing the patient to drink water.

Œsophagotomy.

If all means have failed to remove the foreign body, and inflammatory swelling, impeded respiration, and difficult deglutition are present, especially when deglutition has become impossible, the operation of œsophagotomy ought to be considered. The danger to the patient is now imminent, not only from suffocation and hæmorrhage, but especially from the formation of retro-pharyngeal and retro-œsophageal abscesses, the occurrence of which latter is, in these cases, a frequent and almost always fatal event. The body is, in a large proportion of cases, lodged just below the cricoid cartilage, but it may be reached by an operation when situated anywhere above the sternum. In one case at least, in which the operation was made by Dr. Cheever, of Boston, it has been reached and removed by forceps, after œsophagotomy, when situated below the top of the sternum. If delayed beyond the third or fourth day, pus has usually formed, and the chance of success is greatly diminished.

The first operation of this kind of which we have any account was made by Goursault, in 1738; and, according to Cheever, up to the year 1867, it had been performed for the removal of foreign bodies 17 times, of which operations 13 had proved successful. In 1843, the late Dr. Watson, of this city, performed œsophagotomy for the relief of a patient suffering under a malignant stricture of the œsophagus.

Two modes of operating have been adopted; one, recommended by Nélaton, called the "median," consists in making a tegumentary incision as in the operation of tracheotomy, and then reaching the œsophagus by dissecting up the left lobe of the thyroid gland; or in ligating both sides of the isthmus, dividing it in the median line, and subsequently lifting the left lobe outwards so as to bring into view the œsophagus. The principal objection to this method, in either of its modifications, is the danger of wounding the recurrent laryngeal nerve, which lies between the trachea and gullet.

The other mode, and that which has been usually practised, consists in approaching the œsophagus from the side of the neck, somewhat as in the operation for ligature of the common carotid. The following is the method adopted by Cheever in his second successful operation, as described in his excellent monograph upon this subject:[1]—An incision was made on the left side of the neck, midway between the sterno-cleido-mastoid muscle and the larynx, commencing at the top of the thyroid cartilage and terminating at the sternum, running parallel to the sterno-cleido-mastoid muscle; the anterior margin of this muscle, and the upper belly of the omo-hyoid were exposed; the latter was drawn toward the median line; the carotid sheath was felt and drawn outwards; the left lobe of the thyroid was carefully dissected up and turned over upon the isthmus; the inferior thyroid artery enucleated and pushed aside; the sheath of the carotid separated from the trachea by a director, and this separation increased and maintained by retractors, when the œsophagus was exposed and made distinctly visible by reflected light. A stomach-tube was then introduced through the mouth, and a longitudinal incision made upon its outer wall just below the cricoid cartilage. Having removed the stomach-tube, a search for the foreign body was instituted with the finger, which resulted in discovering a brass pin beneath the sternum. By the aid of a director one end was now loosened, and it was drawn out. During the whole operation not a ligature had been required. The wound was left open, morphia administered by subcutaneous injection, and nutrition maintained by beef-tea enemata, the patient being kept constantly in a warm and moist atmosphere. On the third day he was allowed to drink half a tumbler of milk, of which a portion escaped by the wound, and from this time he continued to take considerable quantities of milk by the mouth. It was observed that a larger portion passed into the stomach when he drank with his head thrown back. At the end of four weeks the wound in the œsophagus had closed, and his recovery was soon complete.

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[1] *Œsophagotomy for the Removal of Foreign Bodies.* By David W. Cheever, M. D., Asst. Prof. of Anat. in Harvard University; Surgeon to the City Hospital, &c. Boston: David Clapp & Sons, Printers. 1867.

It will be observed that no sutures were applied to the wound in the œsophagus; that food was not administered by a stomach-tube; and that no drinks or food were permitted to enter by the mouth until the third day. A careful study of the cases reported, has convinced me that Dr. Cheever's practice in these regards, as well as his mode of operation, are worthy of imitation.

CHAPTER XI.

TUMORS OF THE NECK.

Pre-laryngeal Bursal Tumors.—I have observed a small encysted tumor situated upon the front of the larynx, always exactly or very nearly in the median line; the different examples ranging in vertical position, from a point just above the thyroid cartilage to the middle of the cricoid; the majority lying directly in front of the crico-thyroid space. These tumors have seldom exceeded two inches in diameter, being usually much smaller. They were smooth, round, elastic, having very thin walls, which were closely adherent posteriorly to the larynx, and contained a straw-colored serum, which in one case was mixed with blood. Of the ten examples which have come under my observation, seven were in females. In one the bursa had opened upon the front of the neck, forming a fistula, which had continued to discharge occasionally during several years. One disappeared spontaneously, apparently by having opened into the larynx, through which its contents were discharged, but was soon reproduced. In another case, after a spontaneous recession, it has not returned. I believe these tumors to consist of enlargements of the thyro-hyoid bursæ, or of those accidental bursæ which my dissections have proven to exist, occasionally, in front of the thyroid cartilage.

Treatment.—Tumors of the class now described have never seemed amenable to therapeutical treatment. Attempts to dissect them out entire have also satisfied me that this cannot be done without incurring great risk of opening into the larynx; and of causing, even when this accident does not happen, a sharp and alarming laryngitis. Fortunately it has been found sufficient to lay them open freely, removing such portions of the sac as are superficial. If the sac is not obliterated by the suppuration which ensues—after the lapse of a few days, when the inflammation incident to the wound and to the exposure of the interior has subsided—a cure may certainly be effected by the daily injection of the tincture of iodine; at least, such has been my own experience.[1]

The possibility of confounding the following congenital abnormity with a fistula resulting from a bursa, will render it proper to speak of it in this connection.

Fistulous openings occasionally exist at birth, communicating with the larynx or trachea, which are due to *arrest of development*, and which may occur in the median line, or at corresponding points upon either side. Dr. Pooley, of Yonkers, has reported a case in which two congenital fistulæ existed in the median line, one above the other.[2]

The treatment consists in excision of the margins of the openings, and occlusion by sutures, or in a resort to some similar plastic operation.

Encysted Tumors of the Neck, usually denominated **Hygromata.** Beneath the ramus of the inferior maxilla, on the sides of the neck, and especially in the supra-clavicular triangle, encysted tumors are quite common, resembling in many respects the encysted pre-laryngeal bursal tumors last described, but liable to attain a much larger size; some of which are no doubt bursal, and others seem to have formed in the areolar tissue.

Treatment.—In general, we cannot advise the surgeon to attempt the complete extirpation of these sacs. No doubt some may be safely cut out; but when situated near important cervical veins, arteries, or nerves whose relations to the base cannot be well determined, it will be more prudent to lay them open, and trust to iodine injections to complete their destruction.

Enlarged Lymphatic Glands.—Chronic enlargement of the cervical lymphatics may be recognized by their position, and by the fact that, in most cases, a number of glands are simultaneously involved. These enlargements occur mostly in strumous patients, and often terminate in ulceration. Occasionally, however, when the strumous diathesis is not intense, they remain in a state of induration during an indefinite period.

Treatment.—Therapeutical and hygienic measures, and especially the use of iodine in some of its forms, are the proper remedies. If several glands are simultaneously affected, excision is never justifiable unless the life of the patient is in danger from their pressure upon some important and vital organ; since we can, in these cases, give the patient no encouragement that the removal of the existing tumors will not be followed by the formation of others. I have once removed a chain of enlarged cervical glands, twenty in number, varying in size from a pea to a hen's egg, for the reason that they had begun to interfere with respiration. This was the second operation to which the patient had been subjected for the same cause, and I gave no promise of permanent relief. Two years later the patient succumbed to pulmonary tuberculosis. Velpeau believed that the removal of one gland rather favored the dispersion of the remainder: my experience does not confirm this opinion.

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[1] Paper on Ante-laryngeal Bursal Tumors, by the author *New York Med. Jour.*, March, 1870. Also discussion of same subject before the New York Med. Jour. Association, Nov. 5, 1869, with remarks of Drs. Elsberg, Weber, and others. *The Med. Record*, New York, 1870.

[2] *The Med. Record*, New York, July 1, 1869, vol. iv., p. 195.

Nevertheless, if a single gland is enlarged, and if, after the lapse of many months or years, other cervical glands do not become implicated —its growth being steady and progressive, but showing no tendency to suppurate—it will be proper to remove it by excision. Let the operator be reminded, however, that this is the class of cervical tumors in the removal of which, probably, most of the serious accidents have occurred; and, as I think, because their appearance has led the surgeon to exercise less caution in the dissection. They are solid, movable, and not usually of great size, and they are, in most cases, lifted so abruptly from the surface as to induce a belief that they have no close connection with the deeper tissues. The following example will illustrate the peculiar character of the dangers to which we have reference:—In the winter of 1841–42 a lad was brought to me having an enlarged cervical gland below the right ear, which had been growing four years, and which was of the size of a goose-egg. It seemed to be an example of simple chronic hypertrophy of the gland, unaccompanied by scrofulous degeneration. I decided upon its removal; and accordingly made, over the tumor, a longitudinal incision intersected at its middle by a transverse incision. The external jugular was cut and tied at both ends. The tumor was reached after dividing several consecutive fasciæ, and the dissection was prosecuted toward the base with only the most trifling hæmorrhage. Indeed I had just called the attention of the medical students who were present to the advantage of keeping close to the tumor in these dissections, since we were thus enabled to avoid that plexus of vessels which usually surround solid tumors which have grown slowly and have attained considerable size, when at this moment, while the tumor was a little lifted to expose its base, cutting upon a clean and dry surface of the tumor, fairly exposed to view, a large vein was divided, probably a branch leading from the external to the internal jugular. Immediately there was heard a gurgling sound, such as is occasioned by pouring water from a bottle, which was followed by a gush of blood, deluging the wound and the neck. My patient, almost at the same moment, ceased to breathe, and the face assumed a deadly pallor. To arrest the hæmorrhage, a sponge was thrust into the wound, and, by the aid of restoratives, respiration and the pulse soon returned. After a few moments of deliberation I determined to make an attempt to tie the vein, and for this purpose removed the sponge; but the rapid flow of blood left no opportunity to search for the vessel, and having quickly severed the remaining connections of the tumor, the sponge was replaced. There was no further bleeding, and the sponge was permitted to remain until he had fully recovered.

An examination of the tumor, after removal, showed that the vein was embedded in its base, the tumor having projected itself downwards on each side. About one year later this heroic boy returned to me, having eight or ten similar tumors above and behind the clavicle, which he desired me to remove; but the suggestion was declined, and a few years after he died, as I am informed, of tuberculosis.

There is one additional circumstance connected with this case, of peculiar surgical interest. The sponge left in the wound soon became imprisoned by the granulations, and it was found impossible to remove it in mass. Moreover, it was soon observed that vessels had pushed through the sponge, and that granulations were forming upon its exposed surface; now, when a portion of the sponge was seized with the forceps, and cut away with the scissors, a free bleeding ensued. The patient was subsequently placed under the charge of Dr. Hays, of Geneva, and he has informed me that he was not able to remove the whole of the sponge until the middle of June, about six months after the operation, and that only the smallest fragments could be excised at a time, on account of the bleeding. Since this occurrence I have occasionally seen sponges imprisoned in the same manner, but I do not know that they have ever become so thoroughly vascularized—if I may be permitted to use the expression—as happened in this case; but I am very careful not to leave them in deep flesh-wounds, if it can be avoided.

Several examples have from time to time been reported of the accidental wounding of large veins in the removal of solid tumors from the neck, most of which have resulted fatally, either by the admission of air, as happened no doubt in the case I have related, or by the rapid escape of blood. By the admission of air into some of the large venous trunks about the neck, Roux, March, Stevens and many others—whose names are mentioned in the section entitled "admission of air into the veins"—lost their patients. It is worthy of remark, that in each case of which I have read a detailed account, the dissection was nearly completed, when, in lifting the tumor to reach its base, the vein has been lifted also, and its outer wall separated from its inner, in a manner to especially favor the introduction of air. In each of the cases, the patient died while the surgeon was attempting to secure the vessel; and I cannot but think that my patient was more fortunate only because the sponge was so speedily pressed into the wound; by which, at least, he was saved from the danger of dying from loss of blood.

Lympho-sarcoma is occasionally observed in connection with the lymphatic glands of the neck, forming enormous tumors, which are little amenable to treatment and generally occasion death by their interference with respiration and deglutition. (See Tumors, p. 493).

Carcinoma.— I have never seen the lymphatics of the neck primarily affected with hard cancer; and it is rare to meet with encephaloid or any of the other varieties of soft cancer in this region. In either case, when the diagnosis is fully made out, surgical interference is seldom or never justifiable.

Bronchocele, R. C.; Syn., Goitre; Derbyshire Neck.—Goitre consists essentially in a hypertrophy of the thyroid gland; but there are several varieties of thyroid hypertrophy recognized by surgical writers, of which I shall speak more particularly hereafter.

Goitre is met with occasionally in all countries; but to certain regions it is endemic. It prevails especially in deep valleys, and is seldom seen in dry and elevated positions. It is much more common with females than males, and is especially liable to supervene upon pregnancy, lactation, and upon whatever conditions induce anæmia. In some women the gland increases in size at each period of menstruation. It is often hereditary; and in the valleys of Switzerland, when both parents are goitrous, the children are often cretins.

Causes.—Medical writers have not been fully agreed as to the causes of this malady, and we think it proper to relate, briefly, the result of our own observations in the Valais Canton, Switzerland, where both goitre and cretinism prevail, perhaps to a greater extent than in any other part of the world.

Travelling from Geneva, we passed through the Canton Vaud, and reached the frontier of the Valais Canton at a point where the road crosses the river by an ancient stone bridge, one end of which rests against the base of Dent de Morcles, and the other against the perpendicular sides of Dent du Midi, debouching upon the straggling village of St. Maurice. The Valais Canton, commencing at this "barrière," reaches upwards along the Rhone toward its sources; and from this point the whole physical features of the country appeared changed. Hitherto the valley had been wide and but little shaded by its opposing mountains; from St. Maurice it was narrow, deep, and overhung by the loftiest Alps. Until now the soil of the valley had been warm and fertile; thereafter it was cold, rocky, and sterile. The villages we had passed were neat and flourishing; those we were now entering were dirty and miserable in the extreme. As we continued our journey we observed that the cattle and horses looked small and illy-fed; and the few apple and pear trees which we saw were gnarled and dwarfish. But it was in the people themselves that the most striking contrasts were observed. The inhabitants of the Canton Vaud are intelligent, well formed, and, in general, free from goitre: but here lives a race of beings of low, dwarfish stature, with idiotic heads and tallowy complexions, diseased, deformed, and bearing almost always marks of premature old age, two-thirds of whom carry enormous goitres, and six thousand of whom are cretins, having scarcely more intelligence than the swine with whom they kennel.

goitre. If, however, the cell-like expansion, or hypertrophy, is limited to one or to only a few areolar spaces, with only a moderate hypertrophy of the vascular and connective tissue, it is named cystic goitre. Finally, if the veins and arteries become enlarged out of all proportion to the increase of cells and connective tissue, it gives rise to that condition named pulsating goitre.

Simple hypertrophy is characterized by the slow and uniform enlargement of one or both lobes; forming smooth, oval, elastic, painless swellings on one or both sides of the trachea. If only one lobe is enlarged, it is most often the right; and sometimes, when the isthmus itself is involved, it forms a triple enlargement, or a single oval swelling, occupying a central position upon the neck. In all cases the thyroid tumor is fixed to the trachea, and accompanies it in its movements upwards and downwards; a circumstance which constitutes one of the most important differential signs, as distinguishing it from most other non-malignant growths occurring in this region. It will be remembered, however, that the same fact is observed in examples of pre-laryngeal bursæ.

The *cystic* variety is composed, usually, of one or more globular swellings; being formed of cysts containing, in most cases, a clear serous fluid, but in others—especially when the tumor is multilocular—a dark, grumous fluid, with vascular papilliform growths projecting from the interior of the cysts. It will generally be found, in this variety of goitre, that the portions intermediate to the cysts have undergone little or no hypertrophy.

Vascular or Pulsating Goitre. (*See* "*Exophthalmic Goitre.*")

The thyroid gland is also liable to *scirrhous*, *encephaloid*, *scrofulous*, *enchondromatous*, and *calcareous* degenerations; but all these latter forms are exceedingly rare.

The first of these, namely, simple hypertrophy, is the form most amenable to hygienic and therapeutical measures, yet it has happened to me to see examples of each of the remaining varieties which have improved under the persistent use of iodine.

Goitre seldom destroys life; but such a result occasionally ensues in consequence of its pressure upon the trachea, œsophagus, upon the recurrent laryngeal nerves, or upon the large cervical veins. It is only when the patient is threatened with asphyxia, starvation, or with fatal cerebral congestion, that surgical interference can ever become proper. The resources which surgery offers are: extirpation of a portion or the whole of the gland, ligation of the superior and inferior thyroid arteries, tapping the cysts and injecting their cavities with the tincture of iodine, pressure by adhesive straps, the introduction of a seton with a view to its destruction by suppuration, injections of the perchloride of iron, electrolysis, and, finally, tracheotomy below the gland.

Extirpation with the knife, performed successfully a certain number of times, has, nevertheless, so often terminated fatally, even before the

Death from bleeding, and from the admission of air to the veins, has resulted in other cases upon record, in which the seton has been employed. Injections of the persulphate of iron, practised in one case of pulsating bronchocele, by Erichsen, was followed by much inflammation and suppuration, but, "in the end, the patient was materially benefited." So small a result, obtained through considerable peril, would hardly seem to justify a repetition of the operation.

January 8,1849, I was called to the Rev. E. H. Walkers, of Danville, N. Y., who was suffocating in consequence of the pressure of a goitre. The gland was very large, and it was at first thought that a free incision of the sterno-cleido-mastoid—which was drawn very tense over the tumor on each side—might afford relief; accordingly, this muscle was divided, but no relief ensued. I then decided, after consultation with several medical gentlemen present, to cut through the isthmus down to the trachea. With this view the isthmus was exposed, and a very strong ligature passed between it and the trachea, first upon one side and then upon the other, after which the isthmus was divided in the median line, until the trachea was laid bare. To my surprise, no improvement in respiration followed this operation. As the only alternative remaining, and as death from suffocation was impending, the trachea was opened in the lower angle of the wound and a tube introduced. He now breathed freely, but he survived the operation only three or four days. An autopsy was made, and the specimen, being removed, was sent to me. It was now seen that the gland had completely encircled the upper rings of the trachea, and that the trachea itself had undergone at this point a remarkable constriction, so that it would scarcely admit an ordinary goose-quill. In such a case, and perhaps in many others which may be presented, no operation but tracheotomy could be expected to prolong the life of the sufferer, or to give even temporary relief.

CHAPTER XII.

Torticollis. Syn., Caput Obstipum, R. C.; Wry-neck.

The neck may suffer distortion in consequence of disease, injury, or malformation of the spine; from paralysis of the cervical muscles, from swelling of the cervical ganglia, from spasmodic or permanent contraction of the muscles, and from contraction of the integument—the latter being due usually to burns. The term torticollis has been generally limited to permanent contraction of one or the other of the sterno-cleido-mastoid muscles—usually a congenital affection. It is employed here in a more general sense, as applied to all cervical distortions.

Muscular paralysis is an occasional but not very frequent cause of wry-neck. Its existence can be easily determined, especially by the flaccid condition of the muscle or muscles implicated. The treatment consists in the employment of the electrical current, and in the adoption of general hygienic measures. When persistent and extreme, it demands the aid of mechanical supports for the head.

In strumous children a temporary lateral distortion of the neck is often observed, due to *congestion of the cervical ganglia;* and which is most often relieved by sending them to the country, or by whatever means may improve the general health.

Spasmodic contraction of one of the sterno-cleido-mastoid muscles occurs most frequently, also, in unhealthy children, at about the period of approaching puberty. It is usually transient in its character, and is in most cases amenable to appropriate therapeutical treatment.

A young lady from Montezuma, N. Y., consulted me, having *ruptured the right sterno-mastoid muscle* at its external attachment, by attempting to lift a heavy weight. She did not rotate and balance her head quite as freely as before, but no other permanent inconvenience ensued. I am not aware that any similar case has been recorded.

Permanent contraction, in most cases congenital, and occurring usually in one of the sterno-cleido-mastoid muscles, may, however, involve any of the muscles of the neck. I have met with it in the scalenus anticus and in the trapezius.

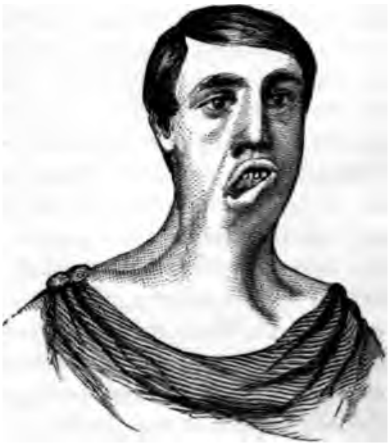
Mechanical appliances are sometimes deserving of a trial in cases of permanent contraction of either of the muscles of the neck; although their operation is always slow, fatiguing, and often ineffective. Subcutaneous section is the most prompt and efficient method, but the history of the section of the sterno-cleido-mastoid muscle proves that this apparently trivial operation is not unattended with danger. The following rules and suggestions may not, therefore, be deemed inappropriate. In dividing the sternal portion, the operator will call to mind the fact that this fasciculus has its insertion, not upon the top of the sternum, but upon its anterior surface, a few lines below the top. It is possible, therefore, to insert the point of the bistoury between the sternum and the tendinous insertion of the muscle, and in this manner to separate its attachment with entire safety. The tendon being rendered tense by elevating the head, an incision is made with a sharp-pointed bistoury near the median line, and into this opening a narrow, blunt, and slightly curved bistoury is introduced, slid underneath the tendon, and its edge pressed downwards along the anterior surface of the sternum, until the attachment is completely severed. In a similar manner, also, the clavicular portion may be divided; but inasmuch as this portion has its insertion on the upper surface of the clavicle, the subjacent vessels cannot so well be protected against the edge of the knife. The patient resting supine upon a table, the chest must be held firmly down while the head is forcibly extended, so as to render the muscle as tense as possible, and thus to lift it from the underlying structures. At whatever point this tension and elevation become the most conspicuous, an incision is to be made from the outer margin through the skin and fasia. Into this opening a probe-pointed bistoury is to be slowly and arefully pushed, hugging the muscle closely, and cutting toward the urface. After the section is completed the head must be retained in he erect position for a time by appropriate apparatus. In some cases leather military cravat is sufficient.

If the contraction is acquired, and comparatively recent, the deformity t once ceases when the section of the muscles is completed; but if of ong standing and congenital, the scaleni and other muscles have probbly become shortened, through arrest of development, and even the ervical vertebræ have suffered distortions, which only the lapse of time an rectify. We can recall one remarkable example, however, the case f a lad seven years of age, whose spine and thorax were considerably istorted—the contraction having existed from birth—in which, having ivided the sternal and clavicular attachments of the sterno-cleido-masoideus, a complete rectification occurred within a period of less than wo years, and without the aid of any mechanical appliances.

In 1868 a child, sixteen months old, was brought to me from Brant o., C. W., who had a congenital contraction of the trapezius, somewhat greater upon the left side than upon the right, and which gave o her head a strong posterior and left lateral inclination. The clavicuar attachments upon the left side were divided with very marked reief; and by the aid of an apparatus the position of the head was subseuently greatly improved. It is a somewhat curious fact, that the father ad a congenital absence of fingers on his left hand, each metacarpal one having attached to its extremity a small fleshy bulb, which I had emoved as long ago as 1854. The thumb of that hand was also conacted upon the palm.

Distortion of the neck *from burns* occurs in every conceivable direcon and degree. In some cases the chin is made to rest fairly upon e shoulder, or upon the top of the chest, and the condition of the unortunate patient appeals strongly to our sympathies. Yet we scarcely now of a class of operations which are more unsatisfactory than those ade for the relief of these deformities. Mechanical appliances some imes give a certain degree of improvement; but only when they have een continuously and judiciously employed for a long time. Simply utting the bands transversely, and then compelling the head to a traight position, never results in any permanent benefit. From plastic urgery alone can the patient expect relief; but the amount of integument to be supplied is often very great; so that when the skin is incised nd detached, and the head is brought to the natural position, a chasm f six or eight inches in diameter is exposed, to cover which, a flap of even larger size will be required, portions of which are almost invariably lost by sloughing and ulceration. The surgeon, if inexperienced in these operations, will find also, to his surprise, that it is not the skin alone which has suffered contraction, but also the subjacent structures, including, in most cases, the superficial muscles.

Fig. 359.



Deformity from a Burn; relieved partially by Transplantation from Shoulder. (Condition before the operation.)

I regret being compelled to say that surgical writers have often greatly misled us as to the amount of good which could be accomplished by certain operations in these cases. They have given us wood-cuts, professing to represent the appearance of patients before and after operations, which, through painful and mortifying experience, I have had to learn were false representations. I have repeated, literally, several of these operations; such, for example, as that of taking an enormous flap from the shoulder and arm, and laying it, by torsion, in the cervical chasm; but with no such perfect results as those represented in the treatises to which I refer. Sometimes the results have been tolerably satisfactory, but they have only been obtained through great suffering, and occasionally at the imminent hazard of sacrificing life. In other examples I have attempted to supply the loss by displacing integument upwards, from the chest, and forwards, from the sides and back of the neck, but in these cases, also, the patients have obtained only partial relief from the vertical contraction; and the conclusion to which I have arrived is, that we cannot remedy, completely, such deformities, and that we ought not any longer to make these great incisions, to be supplied with still larger flaps, but that we should content ourselves with moderate attempts to improve the condition, by small and well-applied incisions, for which only small tegumentary flaps will be required. Whatever method of transplantation is adopted—and the decision of this question must always depend upon the peculiarities of each individual case—the head must be preserved in an erect attitude, by mechanical supports, during the whole progress of the cicatrization; and exact apposition of the flaps must be maintained by properly-adjusted cervical bandages, or cravats.

CHAPTER XIII.

SURGERY OF THE THORAX.

SECTION 1.—WOUNDS OF THE THORAX, AND OPERATIONS INVOLVING THE THORACIC CAVITY.

(*Gunshot injuries* and other *penetrating wounds of the thorax* have been considered at page 107.)

Paracentesis Thoracis, R. C.; Syn., Thoracentesis.

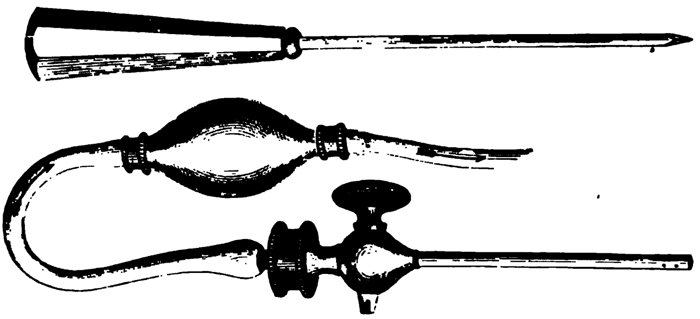
Thoracentesis in Hydrothorax.—The introduction of this operation dates from the discovery of auscultation by Laennec, since which period alone was it possible to render the diagnosis sufficiently accurate to justify such a procedure. Trousseau was among the first to recommend and practise thoracentesis in this class of cases; but to Dr. Wyman of Boston, and later to Dr. Bowditch[1] of the same city, are we indebted for the most complete demonstration of its great practical value.

The operation may be made, first to save life when death is impending; second, to give temporary relief and prolong life in complicated and hopeless cases; third, to shorten the period of convalescence in latent pleurisy.

The objections which have been urged against this operation, and the defence made by its advocates, may be briefly stated as follows:—First, that serum effused into the pleural cavity, when the patient is not already tuberculous, is, in most cases, ultimately absorbed, and a spontaneous cure is thus effected; but such is not always the fact, and its continued presence sometimes determines other grave and fatal lesions. Second, that we may convert a hydrothorax into a pyothorax, especially if, by any accident, air is admitted. The method adopted by Dr. Bowditch provides against the admission of air, and such consequences are thereby rendered less frequent. It is certain that the frequent repetition of the operation, and especially if large amounts are evacuated, occasionally results in pyothorax, whether the air be admitted or not. Third, the sudden expansion of the lungs, by forced evacuation of the fluid, sometimes causes severe pain and exhaustion. This must be avoided by ceasing to evacuate the fluid the moment the patient experiences a feeling of stricture or serious inconvenience. In the opinion of Dr. Flint, the operation "is admissible whenever the pleural cavity remains filled with liquid after a brief trial of the measures designed to promote absorption; and the operation should not be delayed whenever the liquid accumulation is sufficient to involve danger or distressing dyspnœa."[1] As to the supposed danger of wounding the intercostal arteries, the lungs, heart, diaphragm, etc.; it exists only when the previous auscultation has not been carefully made, or the instrument is in the hands of an unskilful operator.

The instrument employed by Dr. Bowditch consists of a small trocar and canula, with or without a stop-cock. Dr. Flint has improved the apparatus by the addition of a flexible and adjustable tube, provided with a suction-bag.

Fig. 360



Flint's apparatus for Thoracentesis.

The point of "election" for the introduction of the trocar is on the back, between the eighth and ninth ribs, below the scapula, and on a line with its lower angle. Guided by the index-finger of the left hand, pressed deeply into the intercostal space, the instrument—without any previous incision of the skin—is plunged quickly into the pleural cavity. The trocar is then withdrawn, and the tube attached; the fluid being removed by the expansion of the India-rubber bag, after its compression with the hand. The instrument should always be supplied with a stop-cock, to be used after withdrawing the trocar and while adjusting the tube, and whenever, in the subsequent steps of the operation, it may be necessary to suspend temporarily the evacuation of the fluid. The instrument being withdrawn, the wound closes spontaneously.

Thoracentesis in Pyothorax.—Pyothorax resulting from gunshot and other traumatic injuries, has already been studied in connection with these accidents; and it is scarcely necessary to say that the indications of treatment are not changed when the presence of the pus in the pleural cavities is due to acute or chronic pleuritis, or to any other cause. The only safety for the patient is in prompt and thorough

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[1] *Treatise on the Principles and Practice of Medicine*, by Austin Flint, M.D. Ed. of 1866, p. 143.

. For this purpose the surgeon may employ at first Flint's
or any instrument supplied with a canula and stop-cock, to
e admission of air; but when this explorative operation has
ded that the contained fluid is pus and not serum, it will be
deed it will be better in all cases, to make at once a free
nd hereafter to treat the case as we have before directed in
raumatic pyothorax.

.—Malformations and Surgical Diseases of the Mammæ and Nipples.

ital Malformations of these organs are exceedingly rare;
les have been reported of bifid nipples, or of two or more
on the same breast (*pleiomastia*). One or both breasts have
d to be entirely absent (*amazia*); and in other cases a supple-
gland, secreting milk, has existed upon the thorax, in the
the back, the abdomen, and in the groin. Variations in
r development of both the breast and nipple are exceed-
uent, but cannot be regarded as abnormities. Occasionally a
opens directly upon the surface of the integument instead of
.

mation and Fissures of the Nipple occur most commonly
t lactation; but, with certain women, this troublesome affec-
at the commencement of every period of suckling. It is
y, to a constitutional predisposition on the part of the mother,
inflammations and ulcerations; but in other cases it must be
to vitiated secretions, or aphthous eruptions within the mouth
l.

nt.—If deep fissures exist, the nipple should be protected
until the ulcerated and sometimes lacerated tissues have had
. The nipple should be washed twice daily with tepid water
en pencilled with a solution of tannin, and afterwards
oughly with cold cream or glycerine. Such astringents as
injurious or very distasteful to the infant cannot properly

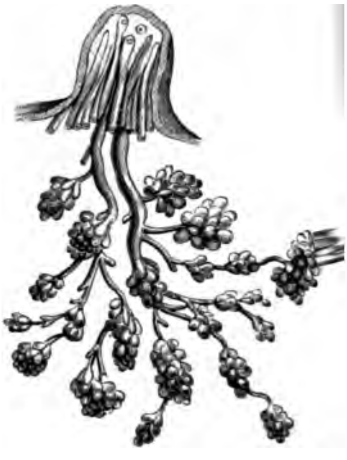
tion and Abscess of the Breast.—Inflammation and sup
etimes limits itself to the subcutaneous connective tissue
to the areola. Inasmuch as this portion of the breast
t, and the tegumentary covering is thin, the matter easily
rface, and will evacuate itself spontaneously if let alone;
r, these abscesses point distinctly, they may be opened;
n ought not to cut very deeply, nor should the line of
transverse, lest some of the lacteal sinuses be laid open,
stula result. In case such a fistula has been formed it
ected to close until after the termination of the period

There are three periods at which the breast of the female is especially prone to hyperæmia and inflammation, namely, immediately after birth, at the period of puberty, and after delivery. In a degree, the male breast is liable to similar accidents at birth and at puberty. It has been shown by Guillot, that both the male and female breast, soon after birth, secrete almost uniformly a small quantity of milk. The fact, therefore, that a few drops of milk may be pressed from the gland in the infant will not be considered by the surgeon as a ground for anxiety or interference.

Nor does the swollen and tender breast of the newly-born infant require, usually, any special attention, except that the nurse shall be instructed not to meddle with it, and that she shall be exceedingly careful in dressing the child, to see that it receives no uncomfortable pressure. If the inflammation proceeds to suppuration, warm fomentations and poultices should be applied; and when pus is formed the abscess must be opened. It is equally important that during the period of puberty, when the breasts are in a condition of hyperæmia and of hyperæsthesia, they should not be subjected to injurious pressure, in consequence of which every now and then active inflammation and suppuration has been induced.

Inflammations occurring at the commencement of the period of lactation are due commonly to two circumstances, namely, to enormously increased activity of the blood-vessels and nerves supplying the gland structure, and to the accumulation of the milk or colostrum, causing obstruction of the lobes, lobules, acini, and milk vesicles.

Fig. 361.



Ducts and Acini of the Mammary Gland. Mo of the lacteal sinuses which go to terminat upon the Nipple are cut off. Two only ar left, with their corresponding radicals.

Among the measures which are known to be most effective in the prevention of this condition, are the early application of the child to the breast, warm or hot applications, and steady, careful pressure with the palm of the hand upon the distended acini; which pressure will be made most efficiently, and with the least danger of causing pain and additional inflammation, if the surface of the breast, or the palm of the hand, is previously covered with sweet oil, and when the pressure is made from the periphery of the gland toward the nipple.

When suppuration has taken place, it may limit itself to one lobe o lobule, or it may implicate several. In the latter case it often become necessary to make successive openings in order to evacuate the pus Unlike similar wounds of the lacteal sinuses, incisions which lay open the smaller tubes or the acini almost always close spontaneously in a short time.

These "milk abscesses," as they are termed, do not usually form within the walls of the lacteal tubes, but in the cellulo-adipose or interlobular structure, the inflammation invading the separate lobules consecutively. They are apt to leave chronic indurations and sinuses, which may demand the use of stimulating injections, and of compression. Compression is best made by a large sponge, moistened and secured in place by bandages.

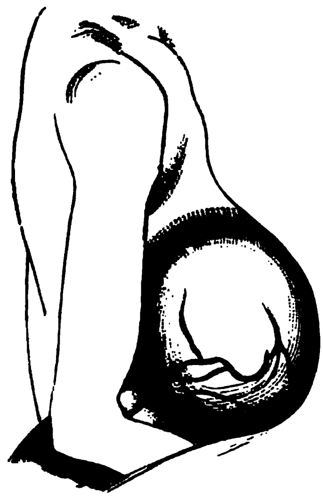
When matter collects between the mamma and the breast, forming a *subcutaneous abscess*, it points early, and is usually terminated after a single opening has been made.

There is also a much more rare form of abscess, occurring sometimes in connection with lactation—a *submammary abscess*—the purulent collection existing between the mamma and the pectoral muscle; in which case the breast is lifted, and surrounded by an œdematous swelling; when pressed upon it gives a sensation as if it were floating upon a bladder filled with fluid. It points, usually, near the posterior inferior margin of the breast.

Mammary Tumors.

The mammary gland, and the tissues adjacent, are liable to a variety of structural changes and neoplasms, constituting tumors. They may be enumerated as follows:—Simple hypertrophy of the mammary gland, the lacteal cystic tumor, adenoid or adenocele, sebaceous cysts, hydatids or acephalo-cysts, adipose tumors, cartilaginous, osseous, encephaloid, colloid, scirrhus, and enlargements of adjacent or overlying absorbent glands.

Fig. 362.



Simple Hypertrophy of the Breast.

Hypertrophy of the Mammary Gland. Syn., Hypertrophia Mammæ, R. C.—Hypertrophy of the mammary gland, so called, occurs most often in females after puberty, and it is then usually associated with some irregularity of the menstrual function. Occasionally the hypertrophy dates from an early period of life. It is characterized by the slowness and regularity of its growth, by the absence of excessive induration, or of any sign of malignancy. In short, it is chiefly distinguished by negative signs, and by the great size to which it may finally attain without in any degree compromising the life or health of the individual.

When these tumors have attained a great size, the original gland structure is found to have been in some measure absorbed, and the hypertrophy is seen to be mainly due to the increase of connective and adipose tissue.

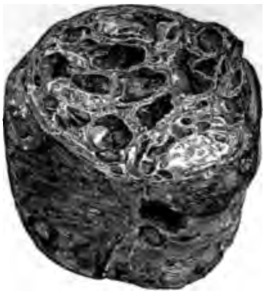
Treatment.—Improvement of the health, re-establishment of the menstrual functions, well-applied pressure, and iodine, are the remedies most to be relied upon. If it becomes a source of annoyance from its great size, it may be extirpated.

Lacteal Cystic Tumor.—The result of obstruction of a lacteal tube, with dilatation or rupture of its walls. This form of tumor commences, in most cases, soon after delivery, forming a round or oblong smooth elastic swelling, which has sometimes been permitted to attain a great size. When the contents of such a cyst are found to have the consistence and appearance of butter, cheese, or casein, the tumor is called *butyroid.* Very rarely an obstructed lacteal duct has been found to contain a small *calculus.*

Treatment.—The cyst must be opened and the contents evacuated; and if a fistula results, it must be treated by stimulating injections.

Adenocele. Syn., Tumor Adenoides, R. C.; Chronic Mammary Tumor, of Sir Astley Cooper; **Pancreatic Sarcoma,** of Abernethy; **Partial Hypertrophy,** of Lebert; **Glandular Tumor,** of Paget; **Sero-cystic Sarcoma,** of Brodie; **Cysto-sarcoma,** of Müller; **Carcinoma Hydatides,** of Sir Charles Bell. The great variety of terms which have been employed to designate these tumors—of which we have enumerated only a few—will sufficiently indicate the variety of histological and morphological changes which they may assume. Sir Astley Cooper and M. Velpeau, in their excellent monographs upon tumors of the breast, have contributed largely to our knowledge of these adenoid growths; nor are we less indebted to Mr. John Birkett of Guy's Hospital, whose valuable communications have contributed much to their history and classification.

Fig. 363.



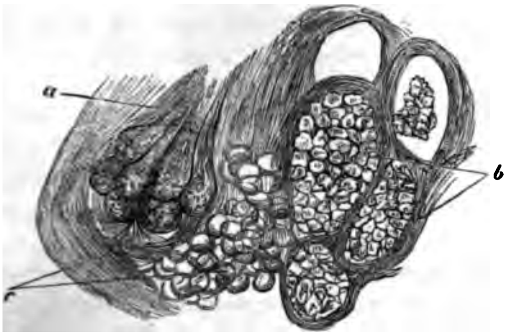
Section of an Adenocele (Cysto-sarcoma) one-fourth natural size.

Adenocele may occur at any period of life, but it is seen most often in women under thirty or thirty-five years. Commencing, usually, at some point near the periphery of the gland, it is noticed at first as a somewhat firm, nodulated, or granular mass, circumscribed, movable, painless, and without tenderness. Its growth is usually slow, and in its progress it seems gradually to involve or displace the mammary gland upon which it reposes. Eventually, if it does not recede, the surface becomes more distinctly nodulated, and presents less of the original granular feel; the interspaces between the nodules become more defined, the nodules—more or less of them—convey an elastic sensation to the touch, as if they contained fluid; occasionally one or more of them ulcerate and discharge a serous or glairy fluid, and then collapse and disappear, or remain for a long time fistulous; or, still more rarely, a red, vascular fungus protrudes through the fistulous orifice.

These tumors are not usually very large, but occasionally they attain an enormous size. In a few instances both breasts have been affected simultaneously or consecutively. Their presence does not materially affect the general health, yet they are often associated with or induced by some irregularity in the menstrual function. They are seldom painful, nor are the axillary glands generally enlarged. From first to last they remain movable upon the subjacent muscular structures.

Pathological Anatomy.—Adenocele is originally little else than an outgrowth of one or more of the lobules of the gland, having nearly all the anatomical constituents of the parent structure, namely, lacteal tubes, acini, vesicles, etc.; and these may be seen, in certain specimens, in the process of development, partially or completely formed. They rest, however, in a fibro-cellular stroma of unusual compactness, and each mass is invested by a firm, fibrous capsule. The healthy portion of gland structure upon which these tuberous masses repose becomes excavated, so that when the adenocele is small it is found underlying the capsule of the breast, attached by a small pedicle, and embedded in the mamma in a cup-like excavation.

Fig. 364.



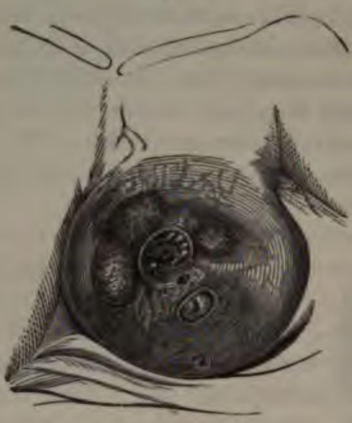
Adenocele, uncomplicated with Cysts. *a*, portion of the normal gland structure; *b*, adenoid new formation; *c*, connective and fatty tissue. 250 diam.

Sometimes the characteristic features above described are preserved throughout the entire progress of the tumor. In other examples, at a certain stage of their growth, cysts are developed in the cellulo-fibrous and sometimes muculent stroma intermediate to the gland structure, which have a compound character; supplementary cysts, either pedunculated or sessile, projecting from the parent cysts, being attached to their inner walls. The fluid contained within the cysts is usually tenaceous and of a pale yellow color. The color is sometimes changed, however, by the admixture of a few drops of blood. Pedunculated, sessile, lobulated masses, resembling gland structures, may be found attached to the interior of the cysts, or to other portions of the new-formed tissues.

In a certain proportion of cases, and more often in those possessing a cystoid character—especially when the tumor has returned after excision—fibro-plastic tissue is found distributed throughout the tumor.

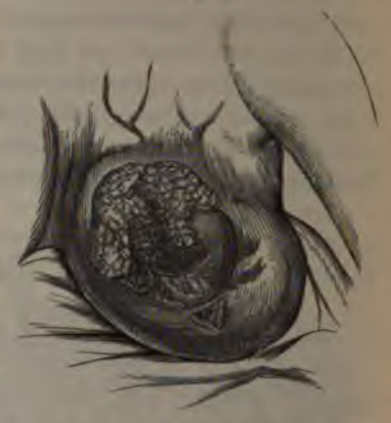
According to Mr. Birkett, a third group, or variety, of these cystoid formations is referable to dilatation of the lacteal ducts and sinuses, upon whose interior walls, also, are seen growths resembling the structure of the gland.

Fig. 365.



Cystic Adenocele.

Fig. 366.



Same six months later, with Cancerous Degeneration.

Treatment.—Adenocele belongs properly to the class of benign tumors. It is seldom that tumors of this nature recur after complete removal, and still less frequent that they assume the character of carcinoma. In a few cases they are found to recede spontaneously, or to yield to well-directed therapeutical measures. Mr. Birkett is not disposed to admit that a genuine new growth, such as doubtless occurs in this case, is ever absorbed. The testimony of Mr. Cooper is otherwise; and only recently a case has come under my observation in which a complete recession occurred in that form which has usually seemed least amenable to treatment, namely, the cystic.

The case is, however, exceptional, and for this reason deserves to be recorded:—I was requested by my friend, Dr. Sayre, to see, in consultation, a young lady, aged 21 years, whose right breast had commenced to enlarge soon after the commencement of menstruation, whe only 16 years of age. During the last year it had grown more rapidl There were two or three distinct tumors or outgrowths situated upon t periphery of the gland, which conveyed to the fingers the sensation solid, granular, lobulated masses. They were movable, and neith painful nor tender. The entire bulk of the gland, including its ou growths, was three or four times the size of the opposite gland. Th young lady was in excellent health, except that her menstruation w irregular and excessive. By our advice she was placed under trea ment with the iodide of potassium, and adhesive strips were applied f the purpose of making pressure. About six months later the tum had much diminished in size, but, in the meanwhile, a cyst had open spontaneously, and discharged about half an ounce of serum. The treatment was continued, and in 1870 no trace of the tumor could be felt.

Nevertheless, when pressure, iodine, and general hygienic measures do not accomplish a cure, and especially if the tumor assumes a cystic character, it is proper to advise extirpation. When the tumor is small, it can generally be removed, with its fibrous envelope, without disturbing the breast; but if very large, if adherent to the subjacent structures, or if considerable fibrinous effusion has occurred outside of the glandular structure, in consequence of which its granular and lobulated feel is lost, it will be better to remove the entire mass. One year since I removed the entire gland, in a case in which one of the cysts having previously opened, a large, round fungus had slowly protruded; and many years ago I amputated the entire breast for a cystic sarcoma, and in neither case has the tumor returned. It will be proper for me to state, in this connection, that the cystic variety is generally accompanied with such increased vascularity of the tissues, as to render it prudent for the surgeon to take extra precautions against hæmorrhage during the operation.

Sebaceous Cysts are of rare occurrence, and generally limited to the areola. Wherever they occur they may be easily recognized by the usual signs characterizing similar formations upon the scalp and upon other portions of the body. The only proper treatment is excision.

Hydatid, or Acephalo-cysts, commonly regarded as entozöotic, are occasionally found in the female breast. Examples have been recorded by Sir Astley Cooper, Mr. Birkett, Graefe, and other writers. They are distinguished by the slowness of their growth, by their globular form and elastic feel; but the only positive means of diagnosis is furnished by exploration. The treatment is incision, with evacuation of their contents; after which a spontaneous cure may usually be expected.

Adipose, Cartilaginous, and Osseous Tumors are also rare, especially the latter. They may be easily recognized by the usual signs indicative of such growths. They are not malignant, and need not be disturbed unless from their size or pressure they cause inconvenience. They are never amenable to therapeutical treatment.

Carcinoma, or Hard Cancer, occurs more frequently in the female breast than in any other external organ or structure of the body. I have met with two examples in the male breast. With women it is most common at about the period of the cessation of menstruation, and is rarely seen at an earlier age than thirty. In a few exceptional cases it is developed as early as twenty, or even earlier. Women who are not married, or who have never borne children, have been thought to be most liable to this affection. Mr. Birkett's observations do not confirm this latter statement; but it accords with the opinions of most surgeons, and with my own observations.

Commencing as a hard nodule, or as a broad, granular induration, situated, in most cases, upon the outer margin, or upon the anterior surface of the gland, not generally movable, nor distinctly separable from the remainder of the gland, it increases in size slowly but steadily. In some cases the early growth of the tumor is exceedingly slow; a small, marble-like induration having been noticed several years before the period at which it became awakened into fatal activity. It is usually sensitive to pressure, and is the occasional seat of sharp, lancinating pains.

At an early period, especially when situated near the centre of the gland, the nipple becomes retracted, and at a later date a drop of blood sometimes escapes from the orifices of the lacteal tubes. Soon the integument covering the tumor becomes apparently thinned, changed in color, and ceases to be movable apart from the tumor itself; the carcinomatous infiltration gradually extends to the whole, or to the greater portion of the gland, which acquires a stony hardness and becomes attached to the subjacent muscles. There remains, however, a certain degree of mobility of the gland, so long as the pectoral muscle is not itself involved in the cancerous degeneration. The tumor, which was at first relatively smooth, acquires, in most cases, a nodulated surface before ulceration takes place. The ulcer is characterized by a deep, irregular excavation, with livid, undermined, jagged edges, having little or no disposition to granulate, and discharging a thin, ichorous fluid, which is exceedingly offensive.

In some examples, the integument covering the breast seems to be primarily affected; the disease presenting itself, at first, as a subcutaneous tubercle. From this single point of induration, the disease may extend until it involves the entire breast; or similar nodules may rapidly form over the whole surface of the thorax. This is the *Cancer en cuirasse* of Velpeau, and the *Cancer lenticularis* of Schuk. Its course is usually slow, and, in so much, the prognosis may be said to be favorable; but it does not admit of removal by an operation. I have seen one example of this kind in which the nodules twice disappeared spontaneously, as I believe, although the patient was at the time under treatment by carbolic acid.

In other cases the entire surface of the skin covering the breast assumes a brawny rugose appearance, and is firmly adherent throughout. The enlargement of the breast in these examples is greater, and according to my experience, carcinomatous tumors of this class present the most hopeless cases for surgical interference.

Eventually the axillary glands, and progressively other absorbent glands in various portions of the system, become involved, the skin assumes a peculiar tawny or yellowish parchment color, indicative of the cancerous cachexy, the fat and muscular tissue disappears under a steady marasmus, and death ensues by a gradual exhaustion of the vital powers, but with the intellect unimpaired to the last. It must be erved that in many cases the marasmus and changes of complexion not occur until a very late period in the progress of the disease.

The average period of the fatal termination of hard cancer of the ast is from two to four years; but in persons of a leuco-phlegmatic nperament, abounding in fat and serum, its progress is usually more id; while in persons whose tissues are dry and destitute of fat, the gress and termination is often much delayed. I have seen one case which an old lady of 70 had borne a tumor of this characte enty-five years; and we have constantly, at the Charity Hospital, num-s of these old, sinewy women, whose cancers seem to make little or progress from month to month and even from year to year.

Cancer in the male breast is of rare occurrence. I have met with twice only; and the records of surgery furnish a few similar ex-ples.

Pathological Anatomy.—When a cancerous breast, of the hard or rrhous variety, is removed, to the naked eye it differs not very widely m the appearance presented by a breast affected with chronic indura-n; it is somewhat harder, less compressible, and usually more lulated. When cut, the surface presents an appearance which has inaptly been compared to the section of a raw potato. On pres-e a thin serous-looking fluid exudes, which is found to contain the cer-cells in abundance, and has been called the "cancer-juice." This enchymatous juice is usually in excess in persons whose tissues are culent, and in those examples in which the disease is making the st rapid progress. In short, it is probable that this fluid constitutes essential medium by which the cancer is propagated along the orbents and throughout the body. In a few examples a section ibits cysts, usually of small size, distributed throughout the interior the mass. Microscopically, cancer of the breast does not differ from same disease occurring elsewhere. (See *Tumors*, Chapter XXIV., rt First.)

Treatment.—The greater frequency with which hard cancer occurs the female breast, and its paramount importance as a human malady, l justify a repetition of some of the opinions already expressed under subject of cancer in general.

No therapeutical means have yet been discovered competent to cure cer; nor, indeed, which are capable of essentially modifying its racter or of delaying its progress. From the earliest period, how-r, the unfortunate subjects of this malady have been the victims of piricism; and even intelligent surgeons are constantly deceived by false representations made by interested or ignorant persons in alf of certain remedies declared to be specifics.

The only question to-day—among intelligent surgeons—is, whether rative procedures are of any value in these cases, and, if so, under t circumstances the knife should be employed. If any still enter-a serious doubt whether caustics are not to be preferred to the knife, it ought to be dispelled by the almost universal testimony of experienced surgeons in favor of the latter.

Those who desire to make farther inquiries upon this subject will do well to consult Dr. Gross's excellent paper on "The Results of Surgical Operations in Malignant Diseases," published in the Transactions of the American Medical Association for 1853. This paper contains Dr. Warren's and my own tables, with the opinions of a large number of distinguished surgeons upon the question of the method of removal, and upon many other practical points; but one single case, which has lately come under my own observation, conveys the whole lesson so far as relates to the relative value of caustics or the knife in cancer of the breast. During a period of about eight years a lady has had a scirrhus, which originally occupied the breast, removed seven times,—four times by myself, twice by surgeons in London, and once by an empiric with caustics. After the six removals by the knife it has never returned in less than one year, but after removal by caustics it returned almost immediately. The operations by incision have never seriously compromised her health, and were made without causing her any suffering at the time of the operation; but although she was assured by the empiric that the destruction by caustic would cause her no pain, she suffered from it "terrible agony," and she became for a time so greatly reduced that her friends despaired of her recovery. As to the value of excision, there is first the testimony of a certain number of cases in which the operation has not been followed by a return of the malady. I have been able to record three of these examples from my own experience, which have not returned after the lapse of many years; and the experience of nearly all surgeons who have operated much will furnish a few similar results; second, the return of the disease has often been delayed several years; third, in other cases the operation has found a justification in the fact, that although the patient has subsequently died of cancer, she has been saved from the suffering inevitably incident to the progress of an open, glandular, and tegumentary ulcer. I have recently seen an example of the latter at Bellevue, where a poor woman whose breast had been removed about one year before, sank without suffering from the progress of the malady internally, but without the renewal of the tegumentary sore. Before she died one humerus broke, in consequence of the cancerous deposit in the bone, and the autopsy revealed extensive visceral infiltrations of cancer.

The latest statistics of the Middlesex Hospital, London, furnish the following results in reference to the question of non-interference or removal by the knife. In cases of hard cancer of the breast, those who were not operated upon survived the first appearance of the tumor on an average thirty-two months, while those whose breasts were excised survived fifty-three months. In cases of medullary cancer the results were still more favorable, since without interference the average ration of life was only twenty months, while, when the knife wa ed, life was prolonged to forty-four months.

The conditions under which we may anticipate the most favorable sults from an operation are the following:—When the tumor has own slowly, is small, movable, unaccompanied with retraction of the pple, the absorbent glands are not affected, and the patient appears be in good health, but whose tissues are not fat and succulent. he operation is justifiable at any period prior to ulceration, provided ncerous infiltrations have not extensively involved the adjacent struc- res, and may warrant a hope that the disease will not return, or that s return will be long delayed.

Amputation of the breast is almost certainly followed by a speedy turn of the affection, either in the cicatrix or in some other portions the body, whenever the tumor has ulcerated or has secured a broad d firm attachment to the ribs, when the integument over the whole and is brawny and adherent, or when two or more axillary glands e involved. The implication of a single axillary gland, especially it be one of the glands near the anterior margin of the axilla, does t in itself contraindicate the operation.

If the operation is made under any other conditions than those med, it can be justified upon no other grounds than the urgent de- e of the patient to avail herself of an extreme and almost hopeless ernative; or upon her desire to be rid, temporarily, of a loathsome l painful external malady, with the hope, moreover, that it may nge the theatre of its action, and that its progress elsewhere may ve fatal before a sufficient period has elapsed for its external mani- tation at the original seat.

Fungus Hæmatodes, Encephaloid and Colloid of the breast are s frequent than hard cancer, and I have seen these forms occur at eriod of life much earlier than is usual for the latter. Their prog- s is usually much more rapid, and the hope of a cure from surgical erference is less. In the few cases of either of the two first men- ned in which I have ventured to operate, the wounds have never eed, or the disease has returned speedily in the cicatrix. Velpeau gards the *colloid* as less malignant than scirrhus.

Melanosis is a still more rare form of mammary cancer; and the ults of operations for its relief are equally as unsatisfactory as in es of encephaloid.

Enlargement of absorbent glands in the vicinity of the breast—oc- rring at all periods of life—may easily be distinguished from cancer l other affections of the mammæ by the characteristic signs of these wths, as they are presented in the cervical region and elsewhere in body. They are seen most often near the axillary margin of the nd.

Amputation of the Cancerous Breast.

The patient reclining upon the back, the arm corresponding to her affected side is held by an assistant at a right angle with the body, so as to render tense the pectoral muscles. Whenever the form of the tumor or the condition of the integument will permit, the form of the incisions should be elliptical, and one extremity of the ellipse should point toward the axilla. However small the tumor may be, the whole gland must be removed, including the nipple, and all of the integument which appears in the slightest degree involved. In the progress of the dissection, also, the knife must be kept well outside of all suspected tissues. After removal, the surface of the wound must be carefully examined, and especially the pectoral fascia and muscles. If axillary glands are enlarged, they must be removed also, either by an extension of the incision in this direction or by new incisions.

When, from the size of the tumor, or for other reasons, we anticipate much bleeding during the operation, the surgeon will find it to his advantage to encircle the chest, above and below the tumor, with a strip of adhesive plaster, drawn pretty tightly; or he may employ for the same purpose pieces of cotton bandage, the ends of which may be intrusted to an assistant, with instructions to draw firmly upon them until the operation is completed and the vessels secured. Of these two methods, after a trial of both, I prefer the use of the adhesive plaster. These measures will not by any means prevent hæmorrhage altogether, but they will restrain it somewhat, and the patient will not be exposed to the danger of those excessive bleedings, both from veins and arteries, which sometimes follow the amputation.

With regard to the bleeding in these cases, there is much difference in the amount, depending upon the greater or less vascularity of the tumor. It is desirable, if possible, to avoid ligatures altogether, so as to insure more speedy union; and this we are often able to do when the patient is thin and the tumor hard and dry. In other cases their employment is inevitable, and especially in that part of the wound which is nearest the axilla.

As soon as the hæmorrhage has ceased, the edges of the wound should be brought together by adhesive plaster, over which broad sheets of lint, covered with simple cerate, must be placed; a thick cushion of cotton batting being laid over the lint, and the whole secured in place by a tight bandage encircling the chest, with occasional oblique turns across the opposite shoulder. The arm must then be laid against the side, with the forearm across the body, and maintained in this position by one or two light turns of the roller.

The important point to be attained in the dressing of the wound is union by adhesion; since experience has demonstrated that the more speedily the wound closes, the less will be the chances of the recurrence of the malady. We no longer hold that the virus may be eliminated by suppuration. It was this doctrine of depurition which, in opposition to the lessons of experience, so long sustained the reputation of escharotics; but whatever depurative power there may be in the act of suppuration, in its relation to certain other maladies, there can be no question that it possesses no such influence over any of the various forms of cancer.

To secure such prompt adhesion, we seek to retain sufficient healthy integument to cover the wound; we avoid ligatures and sutures, if possible; we bind the flaps down firmly, in order that no blood may escape, and cause them to separate from the underlying tissues, and we put the pectoral muscles at rest by making fast the arm against the side of the body. If cotton batting is not employed, the thoracic roller could not be applied sufficiently tight to prevent hæmorrhage, without, at the same time, causing pain and endangering the vitality of the flaps. At the expiration of twelve, or at the most of twenty-four hours, the bandage should be thoroughly loosened, or removed.

The second dressing should be made as early as the third or fourth day; and thereafter, or as soon as suppuration commences—for this cannot, in most cases, be wholly avoided—the wound should be cleaned and dressed twice daily. The omission to cleanse the wound often, especially if it remains open in the axillary space, allows the acrid secretions to rest upon and excoriate the delicate and inflamed tissues, and greatly retards the cicatrization.

Monteggia recommended, after the removal of a cancerous breast, that a large issue be established in the arm of the corresponding side. Mrs. ————, for many years under my observation and charge, and who has since died insane, wore for ten or more years prior to her death a seton in her side, below the false ribs, in order, as she stated, to prevent the return of a cancer of the breast which had been removed from the corresponding side. Whenever the seton was withdrawn the cicatrix became tender and painful, and when re-inserted, the tissues returned to their normal condition. She died without any return of the cancer.

CHAPTER XIV.

ABDOMINAL HERNIA.

SECTION 1.—GENERAL REMARKS.

Definition and Classification.

A HERNIA is the protrusion of any viscus from its natural cavity. Of abdominal hernia there are several varieties named:—First, with reference to the situation in which they may occur, or from the natural or artificial openings through which the viscera may have escaped, as follows—diaphragmatic, epigastric, umbilical, direct and oblique inguinal inguino-scrotal, labial, femoral, obturator, perineal, pudendal, vaginal, rectal, and ischiatic. There is no point, however, of the abdominal parietes, not enclosed by bone, through which a hernial protrusion may not take place; and when occurring at other points than those above specifically named, they are termed ventral. Second, with reference to the nature of the contents; namely, enterocele when the sac contains intestine; epiplocele, when it contains epiploön (omentum); or entero-epiplocele, when it contains both intestine and omentum; cystocele, containing the bladder; hæpatocele, the liver; gastrocele, the stomach; and ovarian. There is no portion of the viscera of the abdomen which has not, at one time or another, been found in a hernial sac, except the pancreas. In a large majority of cases, however, herniæ contain either a portion of the small intestines or the omentum, or both. Third, with reference to the condition of the contents; namely, reducible, irreducible and strangulated. Fourth, herniæ are divided, also, into congenital and non-congenital.

General Anatomy of Abdominal Herniæ.

Nearly all abdominal herniæ have these features in common:—The visceral protrusion is covered by integument, a certain number of fasciæ, and a process of the peritonæum. The exceptions are found in those cases in which the viscera have escaped through the track of a wound, or through the diaphragm; or in which a viscus is protruded having no complete peritoneal covering; and in some examples of congenital umbilical herniæ.

The "sac," in all typical cases, consists of a prolongation of that portion of the peritonæum which lines the walls of the abdomen; and which exists either as a congenital and normal arrangement of the parts, or as the result of the pressure of the viscera against the parietal peritonæum at points where the abdominal walls are weakest. The "neck" of the sac is that narrow or constricted portion which occupies the aperture of escape; and the point where it debouches into the cavity of the belly is called the "mouth." The remainder of the sac, constituting usually the largest and most expanded portion, is called the "body," the lower or outermost portion of which is named the "fundus."

When the sac first escapes from the cavity of the belly it may be easily replaced; but eventually it contracts adhesions to the structures with which it has been brought into contact, and its replacement becomes difficult or impossible. Meanwhile it may increase in size by the evolution and escape of additional peritonæum, or by distention of its walls. In certain cases, and especially in oblique inguinal herniæ, the neck is much elongated, and suffers constriction by a gradual thickening and contraction of this naturally thin and delicate membrane; and this may happen either through the entire length of the neck, or at one or more points. Sometimes the constricted portion is displaced downwards, and a new cervical stricture is formed at the point which the first originally occupied.

Stricture of the neck of the sac can only be found in old herniæ, and it is not always present in these. Ordinarily the stricture is composed of those tendinous, fibrous, or muscular structures which embrace the neck, which may be either in a normal condition, or they may have suffered condensation and contraction in consequence of inflammation; and the release of the imprisoned viscus is effected by simply enlarging, by incision, the parietal aperture. It is apparent, however, that in the case of old herniæ the enlargement of the parietal aperture will not always release the incarcerated viscus; and that, as peritoneal strictures are sometimes found displaced downwards in the course of the canal, so also they may be thrust upwards by taxis, especially after incision of the parietal aperture; and experience has demonstrated that these complications do sometimes actually happen.

Reducible Hernia. Syn., Hernia Reponendi Patiens, R. C.

A hernia is said to be reducible when it can be returned within its natural cavity; but in speaking of abdominal hernia as reducible it is never intended to imply that the sac can be returned, although this is possible in some very recent cases. A hernia is reducible when its contents, whether intestine, omentum, or other viscera, can be made to retire from the sac into the cavity of the belly.

The existence of a hernia is recognized by its situation, by the sensation it imparts to the finger, by its history, and by the possibility of its reduction. The diagnosis is also confirmed in some cases by certain negative signs, or by exclusion.

Herniæ are most commonly found in the situation of natural openings, or at points where the abdominal coverings are the weakest, as at the inguinal and femoral rings, at the umbilicus, etc. To the finger they impart sensations differing considerably, according to the character of their contents, their depth, and the nature of their coverings; but in general they form smooth and round elevations, the projection of which is increased by coughing, straining, standing or lifting; which may be reduced by pressure, or retire spontaneously, when the patient assumes the recumbent posture, and which are accompanied with but little pain or tenderness. If occurring suddenly, while making a violent effort, the subject himself becomes at once conscious of a yielding of the tissues, or of the escape of the hernia, and declares that he has a "rupture." When the sac contains intestine the tumor has an elastic feel, is resonant on percussion, and retires with a gurgling sound. When it contains omentum, it has a more solid, doughy feel. Entero-epiplocele is most common in the inguinal region, and the intestine generally occupies a position in front of the omentum.

General Treatment of Hernia.

The objects sought to be attained by treatment are either temporary retention and support of the hernia, or a permanent cure.

The temporary retention and support of hernia is accomplished by bandages and trusses. A few cases of hernia, such as those examples of congenital deficiency or weakness of large portions of the muscular parietes, with which we occasionally meet, and certain easily-retained congenital, inguinal, and umbilical herniæ, demand only well-applied bandages, or abdominal stays, with or without pads; but most herniæ require for their support carefully-constructed mechanical appliances called trusses.

Trusses have furnished a most fruitful field of invention. The contrivances, with their infinite modifications, may be enumerated by thousands; and one finds it difficult to conceive how the few elementary principles which govern the construction and application of trusses could be worked out into so many changes and combinations of apparatus. The truth is, that the varieties of apparatus are very much less numerous than the names which have been applied to them; nearly all of them appear again and again in different periods of the history of surgery, under new titles, which titles are usually the names of the supposed or pretended inventors. Thus we have in our day and in our own country, Hood's, Chase's, White's, Thompson's, Hull's, Marsh's, Knight's, Culver's, Stagner's, Goulding's, Hubbard's, and a hundred other trusses, every one of which is probably patented, in violation of those sound principles of humanity and morality which medicine and surgery have always inculcated and generally practised; and in spite, also, of the fact that scarcely any of them involve an original principle upon which a patent could be justly claimed.

Many of these trusses are excellent and ingenious mechanical contrivances; indeed I will not say that they are not all useful; but it had better be understood that none of them equal their pretensions, and that good surgery requires that each case of reducible hernia shall be examined and carefully studied by itself, and a truss selected with a view only to its peculiar fitness for the case in hand.

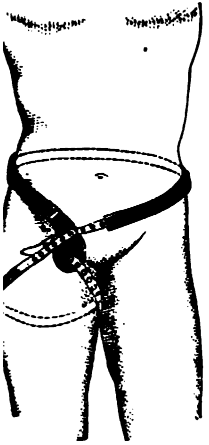
Herniæ which have passed through long, oblique, and superficial canals, like the oblique inguinal herniæ of the adult, are of all most easily managed; since by an ovoid, elliptical, or cylindrical pad pressure may be made upon the whole length of the elongated neck of the sac, and the descent of the viscera may most effectually be prevented. This is the principle upon which the Chase's truss, sometimes known as the "American" truss, is understood to operate. And if the hernia can be prevented from descending during several months or years, a radical cure is very often effected; not, as some foreign surgeons have understood us to say, by causing inflammation and adhesion of the il, but by the gradual contraction, closure, and obliteration which lt from its disuse.

'mbilical, many direct inguinal, and some old oblique inguinal iiæ of large size require that the pad shall rest directly upon, or it actually press into and occupy the external opening, even at risk of enlarging the orifice. Consequently these herniæ are e difficult to retain by mechanical appliances, and trusses seldom mplish radical cures. For umbilical herniæ we employ a ular pad supported by a broad brim, in form somewhat like a ker's hat. This may be made of metal, gutta-percha, or of any erial which has the requisite firmness. The crown or nipple-like jection being made to fit accurately into the aperture, the rim rests n the walls of the abdomen, where it is retained by broad adhesive ps or bandages.

'emoral herniæ present still additional difficulties. That portion he canal which lies underneath Poupart's ligament and the fascia lata eyond the reach of pressure made by a pad; at least it is proper ay that no pressure can be adequate to the complete retention of hernia, without at the same time making injurious pressure upon rbents which enter at this point, and upon the femoral vein, if not n the femoral artery. The numerous glands situated in this region, the delicacy of the tegumentary tissue, render the groin intoler- of continued and severe pressure. Added to all these embarrassments, e remains, chief of all, the motion of the limb in walking, which ls constantly to displace or to render the pressure of a truss unequal.

russes applied for inguinal or femoral herniæ should encircle the body at some point between the trochanter major and the crest of the ilium, and should fit as accurately to the form of the body as possible, so as to make no unequal pressure. In persons who have large gluteal muscles the truss will have to be lifted almost to the crest, or it may be necessary, by the intervention of a broad pad, to make the bearing chiefly on the sacrum. Without these precautions, the hernial pad is liable to be constantly displaced in walking and in the various other movements of the body. A light, firm, elastic piece of steel is the best material for the main body or shaft of the truss. The neck through which the shaft is attached to the pad should be made of firm but malleable iron, so that the proper adjustment may be made. In the case of inguinal herniæ the neck will be in- d obliquely downwards, in order that the pad may rest above part's ligament; and in fat persons, or in persons with pendulous es, the face of the pad should be directed a little upwards. In

Fig. 367.



Femoral Truss.

femoral herniæ the neck must stand at nearly a right angle with the shaft.

The pad may be made of almost any firm material; but hard and not too highly polished wood is the best. Finally, continuous pressure, or pressure which will be continuous during both flexion and extension of the body, always in part effected by the elastic steel shaft, may be rendered more complete by a steel spring placed between the pad and a metallic plate upon which it may be made to rest; or, by the adjustment of a short steel spring to the back of the pad, one extremity of which is made fast to the neck or shaft of the instrument.

It is well to employ always a perineal strap, the better to maintain the pad in position, but it must not be drawn uncomfortably tight. At first, and for some time, a truss will cause considerable discomfort, and it may be removed at night, to be reapplied in the morning before rising from bed. The patient ought to be reminded, however, that it is no uncommon thing for a hernia to descend and become strangulated during sleep.

Radical Treatment of Reducible Hernia.

By the application of trusses which maintain for a considerable time a thorough reduction of herniæ, a permanent cure is occasionally effected; especially may this happen in cases of oblique inguinal herniæ. If a hernia is reduced immediately, or very soon after its occurrence, the sac itself will often be found to be replaced, and there are many chances that if a truss is applied at once, and kept in place steadily, the hernia will never again descend. The same is true of the congenital herniæ of infants; for although we do not in these cases return the sac, a few weeks of retention is often, indeed generally, sufficient to secure an obliteration of the canal.

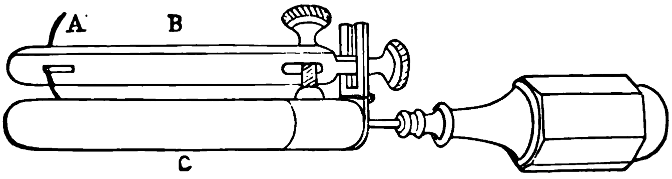
There is, however, a large class of old herniæ in which nothing can be expected from a truss, except to maintain their reduction while the instrument is applied. There are, in fact, some herniæ which cannot be kept in place, even temporarily, by apparatus of any kind, and in which the patient is constantly exposed to the hazards of strangulation, and to the continual annoyance occasioned by its extrusion. In these latter cases, especially, it is very desirable, if possible, to get rid of the annoyance and danger by some radical operation.

Several methods have been suggested and practised by surgeons, some of which date from a very early period, in nearly all of which it has been proposed—having previously reduced the hernia—to obliterate the canal, by causing its opposing serous surfaces to adhere. With this view caustics have been applied to the interior, tincture of iodine and other stimulating liquids have been injected, incisions have been practised, portions of the sac have been excised, the entire sac has been detached and returned within the cavity of the abdomen, forcible compression has been employed, and some have ventured even to apply a ligature around the neck of the sac.

All of these methods were long since abandoned as being accompanied with no inconsiderable danger, and as being almost always complete failures. Only one of them has been practised within my recollection. It is now about twenty or twenty-five years since that, here and there, surgeons were practising injections of tincture of iodine. The plan of operation was to introduce a sharp-pointed subcutaneous syringe into the peritoneal canal, opposite the external abdominal ring, in case of an inguinal hernia, and throw in one or two drops of the tincture. Pressure was then applied, and the patient was kept in bed one or two weeks. During this period, considerable inflammation and swelling ensued, caused by the pressure, and by the presence of the iodine in the canal or in the adjacent areolar tissue—where I suspect it was generally thrown—and it was found that, when the patient left his bed, the hernia did not descend. He was then pronounced cured; but he was directed to continue to wear his truss. It happened to me to see a number of these patients after the lapse of from one to several years; and in every instance the hernia had returned to the same condition as before the operation, and that, too, notwithstanding they had continued to wear the truss. Usually the hernia returned as soon as the inflammatory effusions had entirely disappeared.

More lately, Professor Wützer, of Bonn, and others, have sought to accomplish the same purpose by invagination of the hernial sac. The methods by which this was accomplished were varied by the different operators, but the principle was in each the same. By the aid of a hollow cylinder of wood, the scrotum is thrust upwards into the inguinal canal; a flexible gilt steel needle, fixed in a movable handle, is then carried along the cylinder and thrust forwards through the invaginated scrotum, the hernial sac, and the anterior wall of the abdomen, and made to protrude in front. A "concave wooden case" is now laid upon the surface of the integument, in such a manner that the point of the needle rests in a fenestra at one extremity, while the other extremity is made fast to the outer end of the cylinder, and, by means of a screw, the two blocks are brought together, and the intermediate tissues compressed. The apparatus, thus adjusted, is permitted

Fig. 369.



Wützer's Apparatus for the Radical Cure of Hernia.

to remain six or eight days, or until moderate suppuration is established, when it is removed, and the cul-de-sac stuffed with lint, supported by a bandage. At the end of three or four weeks the patient is permitted to leave his bed, but not without a light truss, which is to be worn a few months.

This operation has been received with a good deal of favor; but I suspect it must be subjected to the same judgment as most, or all of the methods which have preceded. It would be difficult to show why, since the sac is penetrated, it should not subject the patient to the same danger as was found to attend the injection of one or two drops of the tincture of iodine, or simple scarifications. Moreover, according to Dr. Weber, who was formerly clinical assistant to Prof. Wützer, not one of the cases which came under his observation was radically cured; and Mr. Kingdon has furnished Mr. Birkett with notes of sixteen cases which have applied to him for relief after this operation had been made, and the herniæ had returned as bad, or worse than before.[1]

Mr. John Wood, of London, has sought to improve upon this operation of Wützer's by closing the external abdominal ring with a suture, applied subcutaneously; the suture passing through the inner margin of the conjoined tendon, and both the upper and lower tendinous fasciculi which compose the pillars of the ring. An incision is also made through the skin of the scrotum, and the subcutaneous fascia is thrust up, somewhat as the scrotum with its integument was displaced in Wützer's operation, and the invaginated fascia is then retained in the canal by the suture.

The operation is ingenious; but it will probably meet the same fate as all the operations which have already been tried and condemned. It is scarcely possible that it should be otherwise, since, equally with other methods, it depends for its success upon those temporary products of inflammation which constantly disappear on the restoration of the tissues to a condition of health, and which disappear all the more rapidly where they are subjected, as in the present case, to an unremitting strain and pressure.

Indeed it is proper to say further of these operations that, by their most earnest advocates, they have been considered applicable especially to the smallest, most recent, and least troublesome herniæ, and their value has been denied or seriously questioned in all those large, ancient, and inveterate cases, which alone demand resources beyond what the truss, skilfully applied, can supply.

Irreducible Hernia. Syn., Hernia Reponendi non Patiens, R. C.

Strangulated herniæ are necessarily irreducible; but technically only those herniæ are called "irreducible" which are not strangulated, but which, nevertheless, cannot be returned.

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[1] Pathology and Treatment of Hernia, by J. Birkett. *Holmes' Surgery*, vol. 4, p. 243.

A hernia may become irreducible from adhesion of its contents to he sac. This condition is generally observed in old and very large herniæ. I have seen an umbilical hernia thus incarcerated which was as large as the head of a child at two years; and we meet with incarcerated inguinal herniæ which hang as low as the knees. Herniæ imprisoned by adhesions cause much inconvenience, and sometimes obstructions occur, giving rise to colicky pains; but they are not very liable to become strangulated, for the reason that, being old and large herniæ, the apertures of escape are also usually quite large.

Treatment.—A concave truss, or suspensory bag, constitute the only surgical expedients to which we can with propriety resort in these cases. We ought never to think of dissecting the contents from the sac in order to return them into the cavity of the abdomen, unless the hernia has become strangulated, since it is always an operation of hazard. When a hernia is irreducible on account of engorgement or accumulation of fæces, strangulation is very prone to ensue; and in such cases careful and persistent attempts must be made to reduce it by taxis. Constriction of the neck, not yet causing absolute strangulation, constitutes the irst stage of this accident, and does not demand consideration in this lace.

Strangulated Hernia. Syn., Hernia Strangulata, R. C.

A hernia is said to be strangulated when it is not only irreducible, ut, in consequence of pressure and constriction at some portion of its eck, its vascular circulation is also obstructed, and the sac becomes ngested, inflamed, and swollen.

The causes which lead to this condition are not the same in all cases. hey may be:—First, a congested or inflamed condition of the structures tside of the neck of the sac; or, to speak more explicitly, of the struc- res constituting the ring, or aperture of escape. Second, a similar ndition of that portion of the peritoneal process which constitutes e neck of the sac; and especially opposite the tendinous rings. hird, the sudden descent of an unusual amount of intestine or of nentum, or of other viscera, when no previous change has occurred in e condition of the neck or of the tendinous rings. Fourth, permit- ng the contents to remain an unusual length of time in the sac, em- loying violent and ill-directed taxis, applying or retaining a truss fter the viscera have escaped; in consequence of either of which uses the viscera may become congested, inflamed, and swollen. ifth, the escape of the viscera into the sac when they are already in n engorged or inflamed condition; as for example when the patient is ffering under a colic, or diarrhœa. Of these causes, the first and second, garded by many surgical writers as the most active, are, in my opinion, e least; the fifth is, no doubt, as explained by Mr. Birkett, a frequent use; but of them all, the third and fourth are by far the most com- on and the most efficient.

The signs which indicate strangulation are, pain and tenderness of the irreducible hernia; pains resembling colic in the neighborhood of the umbilicus; nausea; vomiting, first of the contents of the stomach, but finally, if the strangulation continues, of the contents of the intestinal tube; and constipation. Constipation is present, in some degree, in all cases of hernia; even when the sac contains only omentum; but not unfrequently, by the aid of an injection, a considerable fæcal evacuation may be obtained from the lower portion of the intestinal canal, and especially from the rectum. The same may happen sometimes without the aid of an injection.

General Treatment of Strangulated Hernia.

Taxis.—The judicious employment of taxis constitutes the first and most important indication of treatment. It has proved, also, in the hands of the inexperienced, a more frequent cause of death than the knife; and more have died from unskilful taxis, probably, than would have died if left entirely to the resources of nature.

The mode of taxis must be varied according to the position and nature of the hernia; but in any case the surgeon must bear in mind that it is usually the congested and inflamed condition of the protruded viscera which has rendered it irreducible and strangulated, and that he is liable, therefore, to increase this swelling, and exaggerate the difficulty of reduction by rude and unskilful manipulation; or if it should happen that the viscus has not already suffered congestion, when the surgeon is appealed to, violent handling and thrusting is certain to give rise to this condition. Surgeons are deceived by the fact that the patients make usually so little complaint while rude taxis is being made. The sensibility is not always proportional to the lesion; and most patients refrain from expressing how much they are hurt, because they are alarmed for their own safety, and anxious for our success in the reduction, while they have no knowledge or fear of the consequences of violence. When, however, the patient is rendered insensible by an anæsthetic, or benumbed by an opiate, the danger is really the greatest, because the sentinel is absent, and no warning can be given. It is enough here to say that taxis ought always to be moderate, steady, and continuous; and that it should be applied with such aids as posture can supply, and in such directions as the anatomy of the structures involved will indicate.

There are other means to which I attach only a secondary importance; and yet which are not to be neglected in certain cases as auxiliaries to skilful taxis. The application of a bladder containing cold or iced water to the hernial protrusion may be regarded as moderate and steady taxis, while, at the same time, it is capable in some measure of diminishing the swelling, and of increasing the chance of liberation of the imprisoned viscera. To be effective it must be continued unremittingly during several hours. No other forms of local applications have in my experience proved of any value. Anæsthetics assist taxis solely by removing the antagonism of the abdominal muscles, and in this regard their value cannot be over-estimated. They have no special influence, in my opinion, over the firm tendinous openings through which the hernia has escaped; nor is it probable that warm baths, bleeding, antimonials, or any remedies of the class called "relaxants," have the power of opening the strictured canals by which the viscera are bound as by hard steel rings.

Posture.—I shall hereafter, in connection with non-congenital indirect inguinal hernia, speak of "posture" as a means of releasing imprisoned viscera, and as especially applicable to herniæ occupying the lower part of the abdominal regions. There is reason to believe, also, that the intestine may be withdrawn by the violent peristaltic and vermicular action induced by tobacco and other stimulating enemata, and even by the action of an emetic. Certain examples recorded by myself in the Bellevue Hospital Reports for 1869 render these suppositions probable; but I am not willing to recommend either emetics or tobacco injections—the latter of which was at one time much employed—on account of their uncertainty, and the immediate dangers which attend their use. Simple rest in the horizontal posture, and especially when more complete quietude is secured by a full dose of opium or morphine, has sometimes resulted in a spontaneous recession of the hernia.

Herniotomy, considered as the final resort in all cases of strangulated hernia, can only be discussed in connection with each particular form of the accident. There are, however, a few maxims relating to this operation which have universal application; one of which merits especial prominence, namely, that more lives have been lost by delay than by too early resort to the knife. Nevertheless, it is not quite certain but that this maxim would have been reversed, if delay did not usually imply violent and prolonged taxis. Recent herniæ suffer more acute strangulation, and admit of less delay than old. Strangulated intestine demands more speedy relief than strangulated omentum.

Prognosis in Strangulated Hernia.—Mr. Hey states that he lost three patients out of five upon whom he operated. It is difficult to find reliable statistics upon this subject to-day—I mean such as the records of an hospital alone can furnish; but it is my impression that the mortality remains about the same as when Mr. Hey wrote, now nearly one hundred years ago.

SECTION 2.—SPECIAL FORMS OF HERNIA.

Inguinal Hernia. Syn., Hernia Inguinalis, R. C.

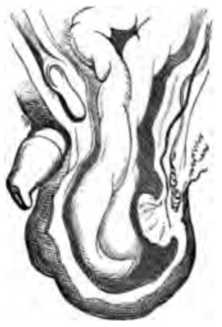
Of inguinal hernia there are several forms and varieties, differing more or less in their anatomical relations, and in other important particulars:—First, inguinal hernia, in the male, is divided into congenital and non-congenital, or acquired. Of the congenital form there is but one variety. Of the non-congenital or acquired there are two well-recognized varieties, namely, the indirect or oblique, and the direct. There are also certain rare and exceptional inguinal herniæ which do not arrange themselves strictly under either of the above-named varieties, such as:—Second, inguinal hernia in the female, which is divided, also, into congenital and acquired; but anatomically it corresponds only to the oblique inguinal hernia of the male, there being no examples of inguinal hernia in the female except such as make their exit through the entire length of the inguinal canals.

Congenital Inguinal Hernia. Syn., Hernia Inguinalis Ingenita, R.C.

Congenital Inguinal Hernia in the Male.—The term "congenital," as applied to this form of hernia, does not imply that the visceral protrusion exists at birth; but only that the peculiar anatomical condition exists, dating from and anterior to the period of birth, which favors its occurrence. In many cases the viscera do not escape until adult life, and in nearly all cases the protrusion takes place subsequent to birth, usually within the first few weeks or months.

The vaginal process of the peritonæum, extending from the cavity of the belly to the bottom of the scrotum, usually just before or soon after birth, closes near the head of the epididymis, so that it becomes divided into two cavities, one lying along the whole length of the front of the cord, called the tunica vaginalis propria funiculi, and the other, expanded and embracing the testicle, called the tunica vaginalis propria testis. At the same time, perhaps—for the date of these events varies somewhat in different cases—the upper canal begins to close from the internal ring downwards; or it may become especially constricted near its middle, and the closure proceed in opposite directions, so that by the twentieth or thirtieth day after birth, according to Paletta, the entire canal is generally occluded. With some persons, however, the canal remains patulous during life, or it closes imperfectly in its entire length, or only at certain points below, leaving the upper portions open, favoring, therefore, the occurrence of hernia so long as this condition remains. Whenever the testicle does not descend until some time after birth, or this event is delayed until late in life, a funicular hernia is very liable to occur.

Fig. 869.



Congenital Inguinal Hernia in the Male.

Symptoms.—Congenital herniæ are most frequent in early infancy; they occur in most cases suddenly, but their descent may be completely arrested at any point of the peritoneal process, constituting, in some cases, only funicular herniæ, and in others, scrotal; while acquired herniæ usually descend very slowly, but steadily and progressively. They are generally composed of intestine alone, and when occurring in adult life the symptoms of strangulation are usually more intense than in similar examples of acquired hernia, because of the more unyielding nature of the stricture; in other respects they do not differ essentially from other inguinal herniæ. Congenital hydrocele is often associated with a patulous condition of the peritoneal process, and may be accompanied with a hernia. It will be difficult to determine the presence of this complication, but fortunately an error in this regard is practically of no consequence, since the treatment must be directed only to the hernia. I have often, however, met with cases of congenital hydrocele uncomplicated with hernia, which have been supposed to be hernia alone. Such an error is scarcely excusable.

Treatment.—It is exceedingly important that congenital inguinal hernia should be reduced promptly and maintained in position; since this is the period during which the normal physiological contraction is taking place in the canal, and any considerable delay may render its contraction and obliteration impossible, or at least very improbable. In a few cases a carefully-adjusted pad and bandage will answer the purpose, but more often it will be necessary to apply a truss.

Strangulated Congenital Inguinal Hernia in the Male.—The same means should be employed for the reduction of these herniæ as have been already declared to be suitable in the management of other strangulated herniæ, namely, taxis, anæsthetics, opiates, and cold or ice-water applications; but it is in these cases, especially when occurring in infants, that taxis may be aided by posture. The child, placed under the influence of an anæsthetic, should be held a few seconds suspended by the feet, as was done successfully in a case reported by my late colleague, Dr. George T. Elliot, Jr. In this position the intestine is withdrawn from the sac by the weight of the abdominal viscera dragging in the opposite direction. I have succeeded, in infants, by placing the body upon an inclined plane, with the hips higher than the shoulders. We encounter one difficulty with children, also, which we do not with adults, namely, the antagonism of the abdominal muscles occasioned by crying. For this reason I have promptly succeeded by taxis when the little patient was asleep, or under the influence of a narcotic. Anæsthetics, in this regard also, give us invaluable aid. When the measures recommended are faithfully tried, the strangulation is almost invariably overcome without resort to an operation.

But when strangulation of a congenital hernia occurs in adult life the reduction is much more difficult, because the narrow or strictured portions of the canal are more unyielding. Especially is this apt to be the case when the visceral protrusion, having existed for some years in the upper portion of the canal, has suddenly extended to the lower portion.

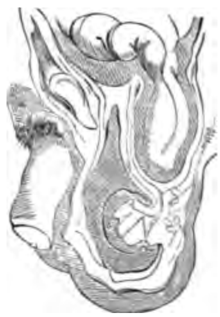
In the "Bellevue and Charity Hospital Reports" for 1870,[1] are two examples which illustrate this observation. This report also contains an example of congenital hernia, accompanied with a peculiar malformation. A German lad, æt. 18, was admitted to Bellevue Hospital, in whom neither of the testes had ever descended, but from the time he was three years old an oblong swelling had been observed in the usual situation of the right inguinal canal. Three days before admission, the swelling had suddenly increased in size, and the signs of a strangulated hernia were immediately presented. Repeated attempts were made to accomplish reduction, and on the fourth day he was brought into one of my wards, exceedingly prostrated, and in a condition to warrant very little hope that an operation would save his life. I operated, however, at once, and on exposing and opening the sac, it was found that there existed a remarkable malformation, which was, no doubt, congenital. The external abdominal ring was two and a half inches in its longest diameter, while the internal ring was removed several inches upwards and outwards. The intermediate space was very wide, and was occupied by the testicle and a coil of intestine. The stricture was found at the internal ring, which, owing to the great depth of the canal, it was exceedingly difficult to reach. It was, however, divided, and the patient made a rapid recovery.

It is quite probable that the above case belongs to the class described as "prolongations of the vaginal process within the abdominal walls;" also as "intra-parietal," "intermuscular," or "interstitial," in which examples the peritoneal process has been found extending laterally in almost every direction, generally beneath, but at other times intermediate or anterior to the muscular and tendinous walls of the abdomen.

Encysted Hernia of the Tunica Vaginalis.

If, in consequence of the closure of the peritoneal process opposite the external abdominal ring, or at any point of its middle course, the abdominal viscera cannot descend through the whole course of the canal, they may be diverted and form a lateral pouch or diverticulum, and they may then continue their descent into the scrotum outside of the tunica vaginalis propria funiculi. The hernial sac thus situated presents no features by which it can be distinguished from the ordinary congenital or acquired hernia: it is nevertheless important to understand that, such an anatomical arrangement may exist, and that, in case of an operation, the cavity of the tunica vaginalis

Fig. 370.



Encysted Hernia of the Tunica Vaginalis.

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[1] *Cases Illustrating Strangulated Abdominal Hernia*, etc., etc., in all Seventy-three Examples, with Practical Remarks, by Frank H. Hamilton.

would probably be first exposed, and that the true hernial sac would be found lying outside of it, and in most cases posterior. No rules can be given as to the manner in which the stricture must be divided, since the point at which the stricture may occur is not uniform.

Congenital Inguinal Hernia in the Female.

A peritoneal process accompanies the round ligament in the female which is precisely analogous to the peritoneal process accompanying the cord in the male. This process is known among anatomists as the "canal of Nuck." It is generally obliterated in the adult, but occasionally remains open during life. Through this canal a congenital inguinal hernia may occur in the female. Indeed it seems quite probable that a large proportion of the inguinal herniæ occurring in the female take this course. They may contain intestine, omentum, the Fallopian tube, or an ovary. I have myself seen one example of congenital ovarian inguinal hernia.[1] These herniæ are not usually large, but they occasionally descend into the labium, or as low as the fourchette, and in rare examples very much lower. When the hernia occupies the labium it is liable to be confounded with a pudendal hernia, but the direction which it takes on retiring will determine its character in this regard. It has sometimes, also, been mistaken for an encysted tumor of the labium.

Assisted by my friend, Dr. Terry, of this city, I have collected twelve examples of *ovarian* hernia occurring in this region,[2] most of which were operated upon before a satisfactory diagnosis was made. In my own case the hernia was caused by the fall of a heavy weight upon the belly when the patient was an infant, the ovary appearing soon after at the external ring as a small movable tumor of the size and form of a large bean. This tumor never disappeared, but sometimes, when playing, another and distinct swelling would present itself beside the first, which could be easily made to retire within the cavity of the abdomen. This was probably intestinal. She began to menstruate when thirteen years old, and from this period the original tumor became painful and swollen at each menstruation, until finally it suppurated and was opened. Five years later the tumor had re-formed, and I opened it again, from which time my knowledge of this interesting case ceases.

Mr. Pott removed both ovaries by ligatures, in a woman twenty-three years of age, evidently from misapprehension of the nature of the tumors, with the result that she became more muscular, menstruation ceased, and her breasts disappeared.

Dr. J. C. Nott, of this city, met with an ovarian hernia at the inguinal ring in a lady sixty years of age, which, being strangulated, he was able finally to reduce by taxis. The diagnosis was much aided in this case the relation of the internal epigastric artery to the internal ring remains the same as at birth; it still lies close to its inner margin, and as the internal ring constitutes the entrance or "mouth" of the oblique inguinal hernia, the artery is constantly upon the inner side of the hernia. It is equally so in the congenital and in the acquired hernia, for the reason that both traverse the inguinal canal. In very rare and exceptional cases the internal epigastric has arisen from the obturator, when, in order to reach its destination, it has crossed the internal ring near its upper border.

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[1] *Bellevue Hosp. Reports*, 1870, p. 159.

[2] *Ibid.*, p. 159.

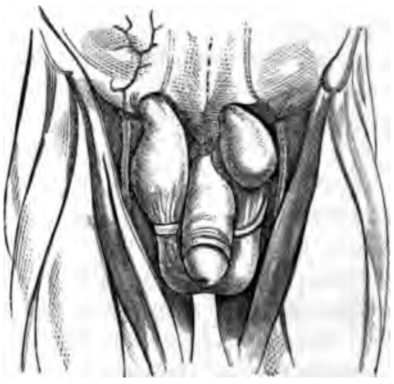
The peritoneal sac, thrust forwards by the pressure of the viscera, enters the internal ring in front of the cord, and in its course becomes invested with the various structures which oppose its progress; namely, the "fascia propria," or "internal spermatic fascia," composed of the fascia transversalis and the loose areolar tissue interposed between the fascia transversalis and the peritonæum—to which latter subperitoneal tissue Velpeau restricted the term "fascia propria;" the "fascia cremasterica," composed of the widely separated but often hypertrophied fibres of the cremasteric muscle and the intermuscular connective tissue; the "intercolumnar fascia," known also among anatomists as the "external spermatic fascia," formed of that delicate sheet of connective tissue which unites the tendinous margins of the external ring, in connection with a few straggling intercolumnar tendinous fibres; the "fascia superficialis," which is sometimes divisible into several layers; and, finally, the integument.

The internal ring becomes in time firm and almost tendinous in its structure, and constitutes, in the large majority of cases, the seat of stricture. The external ring, also, loses eventually its triangular form, and is oval or rounded, and quite unyielding, but it is usually larger than the internal ring, and is therefore less often the impediment to reduction. In exceptional cases the stricture occurs at some intermediate point; or the whole length of the inguinal canal may have suffered constriction.

Through the whole course of the canal the hernia lies in front of the cord. Exceptions have, however, been met with, in which the hernia has separated the components of the cord, portions of it being found in front. In most cases the hernia descends no lower than the top of the testicle, and the latter organ can be felt and seen lying below and rather behind the hernia; in other cases the hernia reaches the base of the scrotum, and the situation of the testicle can only be determined by a careful digital examination.

Diagnosis.—In most cases it is not difficult to decide that a patient has an inguinal hernia; but it is often impossible to say whether it is direct or indirect, congenital or non-congenital. For example, the canal, in the case of an old indirect inguinal hernia, loses generally its oblique direction, the internal ring having undergone a displacement, or an elongation in a direction toward the median line, so that the two rings are now again, as in infancy, nearly opposite to each other. It is a hernia technically "oblique," but which has become actually nearly straight. In such a case it is only possible to establish the differential diagnosis between the direct and oblique hernia by a reference to its early history. If it can be ascertained that it appeared first in the usual situation of the internal ring, the diagnosis is complete, but if no information can be obtained upon this point, diagnosis is impossible. Nor can we in all cases determine whether the hernia belongs to the class termed congenital. If it is known to have existed early in life; if the testicle has only partially or recently descended, or if it is still wholly concealed within the cavity of the belly; if the hernia has taken place suddenly, when the viscera were under no very extraordinary pressure, it may be suspected to be congenital.

Fig. 371.



Oblique and Direct Inguinal Herniæ. Both enclosed in hernial sacs.

While the hernia remains in the inguinal canal, constituting a bubonocele, it may be mistaken for *a testicle not descended*; but the peculiar pain caused by pressure upon the latter is sufficiently diagnostic. I have seen at Bellevue Hospital a case of inflammation of the cæcum—*typhlitis*—in relation to which a question arose as to whether it was not a strangulated bubonocele. The constipation, a condition which usually accompanies typhlitis, increased the embarrassment; but the tumor was too broad, and the symptoms were too mild to warrant a supposition that it was a strangulated hernia, and the result confirmed this conviction. It is possible also to confound *inflammation of the appendix vermiformis* with bubonocele; but neither the cæcum nor the appendix are in the precise position of the internal ring; both being situated a little higher and somewhat nearer the spine of the ilium.

Occasionally, an abscess which has originated from the lumbar or iliac region passes through some portion of the inguinal canal; or an absorbent gland may become swollen and suppurate; an encysted tumor is very rarely found within the canal; still more rarely a hæmatocele; finally, fatty and other tumors are occasionally seen to originate here. From all these the differential diagnosis is in most cases easy.

When the hernia has escaped from the external ring it may be confounded with *hydrocele of the cord*. I have lately seen a case in which the difficulty of diagnosis was increased by the fact that the patient had been subject to a hernia for many years, which he was accustomed to reduce himself, but no one had entertained a suspicion that he had a hydrocele. When he consulted me, a hydrocele, which was as large as a hen's egg, occupied the situation of the external ring. This had been pronounced an irreducible hernia. I tapped the tumor and evacuated the serum, and a few weeks later made a radical operation for its cure; and as yet the hernia has not again appeared.

Varicocele is sometimes mistaken for scrotal hernia; from which, however, it may be distinguished by the peculiar feel, and especially by Sir Astley Cooper's "posture test." The patient lying upon his back, the enlargement, whether hernia or varicocele, may be made to nearly or quite disappear. If now a finger is thrust into the ring, and the patient made to stand erect, a varicocele will soon return, but a hernia cannot. From a *hydrocele of the tunica vaginalis* a scrotal hernia will be distinguished by the more tense and elastic feel of the hydrocele; by the fact that the latter is usually pyriform in shape, with its largest extremity directed downwards; it cannot be made to retire; and, if its history is obtained, it will be ascertained that the enlargement commenced below, while in hernia it invariably commences from above. Hydrocele of the scrotum and hydrocele of the cord may coexist with hernia.

Treatment.—Reducible indirect inguinal herniæ are, in most cases, easily retained in place by trusses whose pads are elliptical in form, and which are made to cover a large portion of the inguinal canal. (See general remarks on treatment of reducible hernia.) In order to make taxis when this hernia is strangulated, the patient must be laid upon his back, with the thighs flexed upon the abdomen and adducted. The direction of the taxis should be at first backwards, and, subsequently, upwards, outwards, and backwards; and the surgeon must take care to follow the hernia until it has entirely disappeared beyond the internal ring.

In this, as in all other forms of inguinal hernia, advantage may often be derived from "posture," as described when speaking of infantile congenital hernia, namely, by elevation of the lower portion of the trunk, so as to cause the hernia to be withdrawn by the weight and traction of the abdominal viscera; but instead of lifting the adult patient by the feet, as recommended in the case of children, it is my practice to place the lower foot-posts of the bedstead upon a table, which leaves the patient upon an inclined plane, with the head directed downwards. The effect of this posture may be increased also, somewhat, by pressing the abdominal viscera towards the chest. In the Bellevue Hospital Reports already referred to I have recorded three examples (Cases 43, 44, and 48) reduced by this method after ordinary taxis had failed; and I have, since the publication of these reports, met with two more in the same hospital.[1]

It is needless to say that chloroform and opium have the same value in these cases as in other examples of strangulated herniæ, for a full consideration of which the reader is referred to the "general remarks on the treatment of hernia."

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[1] "Posture in Strangulated Hernia," by the Author. The *Hosp. Gaz.*, Jan. 7, 1879.

Operation for Strangulated Indirect Inguinal Hernia.—Inasmuch as this form of hernia is the most frequent, and, therefore, in some sense typical, I shall describe the various steps of the operation more in detail than in any other of the several forms. Indeed, it has seemed most convenient in this connection to supplement the "general remarks" by a special application to the variety now under consideration. How far the following observations are applicable to other varieties of hernia, the reader will readily comprehend.

The patient, placed under the influence of an anæsthetic,—the parts having been shaven and the bladder emptied,—is laid upon his back, with the thighs a little abducted and rotated outwards. An incision is then made from a point a little above the upper margin of the external ring to near the bottom of the sac, unless the length of the sac exceeds four or five inches, dividing successively the integument, superficial fascia, intercolumnar fascia, fascia cremasterica, and fascia propria. The knife may at first be applied somewhat boldly; and it is probable that the incision of the superficial fascia will expose the superficial epigastric artery, which must be cut and tied. The dissection beyond this point should be conducted with more care, since there exists the greatest diversity among different persons in regard to the thickness of the hernial coverings. In certain emaciated patients we come almost at once upon the sac; while in others the inflammatory effusions, added, perhaps, to an unusual quantity of adipose and other tissues, cause the sac to recede to a great depth. Surgeons sometimes pick their way by the aid of forceps, or by thrusting a grooved director under each successive layer; and no doubt they thus avoid the danger of an untimely or reckless incision of the sac; but this method is slow and tedious, and I have always preferred to use a sharp knife, making long, clean incisions, keeping the surface of the wound free of blood, and observing attentively each structure as it has been brought into view. It is true that we cannot always recognize the several fasciæ as they are exposed, and assign to them their appropriate names, for the reason that the fasciæ, as seen in the cadaver, bear very little resemblance to the same fasciæ as seen in the case of a hernia and during life; they are, in the latter case, attenuated, hypertrophied, or changed in color; they may be swollen and massed by inflammatory infiltrations; or by long pressure they may be compressed into a single sheet of exceeding tenuity. Sometimes also, in old herniæ, instead of the four or six classical coverings, there may be fifteen or twenty. In one case of old epiplocele I demonstrated fourteen fasciæ, and could have made several more, had I not been admonished by my patient that he wished me to finish my operation, and not to make a "dissection." Too much importance has been given to these fasciæ by anatomists; and it would be quite as well for the patient if the surgeon were to dismiss them wholly from his mind, and only take care that the several steps of the operation were conducted with prudence and caution.

The sac is the anatomical point for which the operator should especially aim, and the appearance of which he ought fully to understand, since it presents, in nearly all cases, a great uniformity in this respect. Vessels having an arborescent form are seen spread over its surface; it is of a bluish color, slightly translucent, and, if the hernia is tense, the fascia propria, when cut, gapes and exposes the sac plainly to view. In these regards it is unlike all the other coverings and, when once seen in an operation, it can always afterwards be easily recognized.

The sac being fairly exposed, a small fold may be raised at its most depending point, and an opening made, large enough to introduce a director, and upon this the incision may be enlarged. The advantage of entering the sac near its base is, that it generally contains a little serum at this point, which protects the intestine from the knife; while, at a higher point, the contained viscera are often in contact with the sac, and not very unfrequently adherent. Serum is present in nearly all cases of enterocele, and occasionally in cases of epiplocele. Not unfrequently it gives out a fæcal odor; and when the strangulation is more intense, it is colored with blood corpuscles.

The intestine will be recognized by its form and color. It is usually of a dark red or brick-dust color, sometimes purple, and it is convoluted or folded somewhat upon itself. If the sac contains both omentum and intestine, the omentum will be in front; and in all cases where omentum is found, a search should be instituted to ascertain whether there is not a small knuckle of intestine behind. After a careful inspection of the contents of the sac, and having decided that it will be proper to reduce the viscera, it may be expedient to attempt the reduction first, without dividing the stricture. I have reported two cases in which this has been effected, when the sac was opened, by the application of very slight pressure. (Cases 32 and 40 of Bellevue Hosp. Reports, 1870.)

With the finger, or with a large probe, the surgeon now ascertains the point of stricture. If it is at the external ring, the incision should be directed upwards and outwards, dividing the transverse fibrous bands of the intercolumnar fascia. If the stricture is at the internal ring, a narrow probe-pointed bistoury, having a cutting edge of only about one inch in length, must be carried flat-wise along the finger until the stricture is entered, when its edge must be turned directly upwards, and the stricture divided by pressure, rather than by the usual sawing motion.

It is proper to ascertain, if possible, before operating, whether we have to deal with a direct or an indirect inguinal hernia; but the difficulty of diagnosis is so great in many cases, that the only safe rule i that first given by Sir Astley Cooper, and since followed by nearly all surgeons, namely, to cut upwards. It is not true, however, that by this method all danger of wounding the internal epigastric is avoided, since whenever the epigastric arises from the obturator, as happens in a small proportion of cases, it will be found crossing the mouth of the sac above. Whenever, also, an old oblique inguinal hernia has become straight, in the manner already described, the artery will be looped or folded inwards, and it will be found on three sides of the ring, namely, on the inside, below, and above. It is to provide against either of the above cases that I recommend cutting the stricture by pressure rather than by sawing. We may also avoid wounding the artery if we dull the edge of the knife a little, by drawing it lightly across the corner of a brick, thus rendering it slightly serrated; when, by a sawing motion, the stricture will yield, but the artery, if touched, will not be wounded.

The stricture is in a few cases found near the middle of the canal, forming a kind of "hour-glass contraction;" or it may occupy the entire length of the canal. The incision in these cases is to be made in the same direction as if the stricture were at the internal ring.

We have supposed the surgeon to have decided, before dividing the stricture, upon the propriety of reduction; but it will be necessary now to inquire what are those conditions which forbid the return of the viscera into the cavity of the belly, and how we should treat those cases in which the reduction would be unsafe.

In case it is intestine with which we have to deal, it may be found adherent. If these adhesions are recent, it will be proper to separate them by the employment of moderate force, tearing the intestine gently from the sac with the finger. If, also, they are ancient, and consist only of a few long, tough bands, they may be separated by the scissors; but if they are firm, close, and extensive, there is no alternative but to relieve the stricture, and leave the intestine where it is found. Such cases, however, are not very often met with. It is much more common to find slight adhesions at the point of stricture, or along the neck of the sac, which are, in most cases, overcome by the first attempt to explore the rings; or which, while they cannot be broken away, do not prevent the reduction of the intestine.

A dark red or purple color does not imply that the intestine is dead, or liable to die, but that it is inflamed and congested; but if it is of an ashen color, or brownish yellow; if it has a leathery feel· if it crepitates on handling; if the color does not return after pressure,—under either of these circumstances it will be most prudent, having relieved the stricture, to leave the intestine in the sac; or at least, having returned it, to permit the wound to remain for some time entirely open.

Before returning the intestine it should be drawn a little out, in order to expose the point of stricture, when, occasionally, a perforating ulcer is found; and in such a case reduction would, in all probability, prove fatal.

It is remarkable how many recover in whom an artificial anus is formed by ulceration or sloughing of the intestine after strangulation, particularly when the opening takes place at the most projecting point of the knuckle. When the lesion is at the point of stricture death is more likely to occur, and the final cure of the artificial anus, if the patient recovers, is much more difficult; but I have seen several recover completely and without surgical interference when the opening was outside of the neck, and, indeed, I think more of these patients have recovered than have died.

When the sac is occupied by omentum, adhesions may be broken up with much less danger. I have never found omentum in a gangrenous condition; but it is often slightly ulcerated and still more often hypertrophied, and when it is either ulcerated or hypertrophied it should be excised. Three cases in which I cut away ulcerated or enlarged omentum recovered; one in which I first ligated the omentum, and then excised, in pursuance of the advice given by some operators, died; and most or all of the cases in which I have returned the omentum, when not in a normal condition, have died also. Care must be taken that there is no intestine behind the omentum, or involved in its folds, lest it should be wounded; and the excision should be made with a knife, cutting close to the ring. Usually some adhesions exist which prevent its withdrawal from the ring after excision; but the remnant of the omentum has never served as a plug, preventing the future descent of the hernia, as Sir Astley Cooper suggested it might. In no case have the vessels of the omentum bled sufficiently to require the ligature, but other surgeons have reported cases of fatal internal hæmorrhage after excision. I cannot persuade myself that it would ever be advisable to leave the whole mass of omentum protruding, notwithstanding the success which Mr. Holmes says has attended this practice in St. George's Hospital, where, of eleven cases thus treated, "many recovered;" but the ligature seems to have been even more successful at this hospital than the plan just referred to, since of twenty cases only "a few died." Neither plan commends itself to my judgment; and I cannot but entertain a suspicion that there is some error in the statements as to the results.

If both omentum and intestine have descended, the intestine should be reduced first. The reduction of the intestine, even after the complete release of the stricture, is often the most difficult part of the operation; and it is probable that the rough handling to which it is often subjected, in the vain attempts to push it in, is among the most frequent causes of a fatal result. The anæsthesia ought now to be complete; and the surgeon should seize gently between his thumb and forefinger that portion of the intestine which seems to have descended first, and as close to the ring as possible; then pressing with one finger of the opposite hand against the opposite limb of the gut, near the ring also, he should glide his finger in and out alternately until the major portion of the gut is reduced, when, perhaps, the remainder may be made to retire by steady pressure upon the protruding mass. Sometimes the reduction will be facilitated by seizing the sac and drawing it downwards while the intestine is pushed upwards.

Finally, a thorough exploration with the finger must be made as far as the internal ring, to render it certain that the reduction is complete.

Reduction being accomplished, the wound should be closed by sutures, a compress spread with simple cerate, and a bandage. Adhesive strips are not usually of much service in this region; and I prefer that the edges of the wound, especially at its most depending part, should gape a little, or at least that it shall not be hermetically sealed, since under these latter circumstances pus is apt to make its way back and sometimes lead to fatal results.

The patient must be kept rigorously confined upon his back in bed for several days. He must not be permitted to rise even to pass water or relieve his bowels; and the wound must be dressed and cleaned daily. Opium, in doses of one-half or one-quarter of a grain, may be given two or three times in the twenty-four hours, provided pain, restlessness, or diarrhœa seems to require it. It is seldom necessary or proper to disturb the bowels with cathartics, since in most cases evacuations occur spontaneously soon after the strangulation is relieved; and not unfrequently it is followed by a copious and exhausting diarrhœa. In consequence of the use of anæsthetics we now observe, occasionally, that the vomiting does not cease when the strangulation is relieved. This did not happen before the introduction of anæsthetics; and we used to regard the continuance of nausea as a sign that the viscera had been only imperfectly reduced, or that the case was about to terminate fatally. The patient and attendants must be warned that, if vomiting takes place, the wound shall be well supported by the hand, lest the hernia should be again thrust out.

Herniotomy by Release of the Stricture outside of the Sac.— I have reserved the consideration of this mode of operation to this moment, for the reason that it is my opinion that, if practised at all, it should be reserved for exceptional cases. The difficulty, if not impossibility, of verifying the actual condition of the strangulated viscera, and of deciding upon the propriety of returning them, until the sac is laid open, together with the well-recognized fact that in very many cases the seat of stricture is in the sac itself, must compel us to accept of this method with hesitancy and caution. Nevertheless, if one could make sure that the viscera were neither adherent, ulcerated or sloughing, and that the stricture was wholly external to the sac, the chances of recovery must be increased by not wounding the peritonæum. How this assurance can be obtained I am not able to state. The more recent and the less intense the strangulation, the greater would be the probability that the conditions were appropriate for external division; and this is perhaps all that can be said. It might seem proper in these cases to expose the external ring and divide its tendinous fibres, and then wait a moment to observe whether the hernia would not retire spontaneously, or by the application of moderate pressure; and in this way I have once succeeded. Or in case of the failure of this experiment, the internal ring might be reached carefully and divided in the same manner, to be followed likewise by the application of moderate pressure; but in no case would it seem to me proper to attempt, by any considerable amount of force, a reduction of the viscera with the sac unopened.

Direct Inguinal Hernia.

This variety of hernia escapes from the cavity of the belly by a route both short and direct. The peritoneal sac, with its contained viscera, pressing forwards where the outer margin of the rectus is attached to the crest of the pubes, divides, or thrusts before itself the fibres of the conjoined tendons of the internal oblique and transversalis, enters the inguinal canal just as it is about to terminate below, and at once emerges from the external abdominal ring. In exceptional cases the hernia enters the inguinal canal near its middle, and the conjoined tendons are then pushed aside toward the pubes. It may now descend in the male into the scrotum, or, in the female, into the labia.

When the hernia does not carry before itself portions of the conjoined tendon, the coverings are the same as in indirect inguinal hernia. When it does—and this constitutes the most frequent variety of direct hernia—the fibres of this tendon are substituted for the fascia cremasterica.

The internal epigastric artery is in all cases upon the outside of the mouth of the sac, and the cord, at the point where the hernia traverses the inguinal canal, is also to the outer side. The artery holds the same relation to the internal ring in the female as in the male; and in the female the round ligament holds the same relation to the hernia as the cord in the male. These herniæ are never congenital, and only form suddenly, when they are the result of violence.

In both the male and female the hernia sometimes does not traverse any portion of the inguinal canal, but escapes through an opening formed in the tendinous fibres of the external oblique muscle.

Treatment.—Neither in the general management of these herniæ, nor in the operation in case of strangulation, is there anything deserving especial mention which has not already been said in the general remarks on hernia, or in connection with the treatment of indirect inguinal hernia. The stricture may be at the internal or external ring, or at some point intermediate; and, in case it becomes necessary to divide the stricture, it will be remembered that the rule, that the knife should cut directly upwards, is always the safest, since it is possible that there may be an error in the diagnosis.

Femoral Hernia. Syn., Crural Hernia; Merocele.

Anatomy of Femoral Hernia.—A femoral hernia makes its escape from the cavity of the abdomen underneath Poupart's ligament, and to the inner side of the femoral vein, enters the femoral canal at the femoral ring and emerges at the saphenous opening. The femoral ring and canal is larger in the adult female than in the male, and this is probably the principal reason why femoral herniæ are so much more frequent in women than in men.

The "femoral ring,"[1] called also the "internal femoral ring," is bounded anteriorly by Poupart's ligament, posteriorly by the pubes, internally by the free concave margin of Gimbernat's ligament, and externally by the femoral vein. The common sheath of the femoral artery and vein embraces these vessels very closely in the lower and middle portions of the thigh, but about one inch below the saphenous opening its attachment becomes less firm, and the inner or pubic wall of the sheath gradually diverges from the veins until it touches the free concave margin of Gimbernat's ligament, and, entering the femoral ring, becomes continuous in front with the fascia transversalis, and posteriorly with the fascia iliaca. This arrangement of the "femoral sheath" gives rise to a funnel-shaped canal, situated between the inner wall of the sheath on the one hand and the femoral vein on the other, the mouth of which opens into the abdominal cavity at the femoral ring, and whose opposite extremity is at or near the lower margin of the saphenous opening. Into this infundibuliform process the femoral hernia descends, and it constitutes, properly speaking, the "femoral canal." The mouth of the femoral canal is not, however, absolutely patulous, but it is occupied by loose areolar tissue, a few lymphatic vessels, and sometimes a small quantity of adipose tissue, constituting what is known among anatomists as the "septum crurale," and, when presented in front of a hernia as a condensed fibrous sheath, is called the "fascia cruralis." It is customary to describe the femoral canal by those boundaries which lie outside of the femoral sheath; and in order that our description may be complete and intelligible, it will be necessary to mention these additional limitations. The femoral canal is, in this view, bounded superiorly by the femoral ring; inferiorly by the upper edge of the saphenous opening; in front by Poupart's ligament and the falciform process of the fascia lata; behind, by the body of the pubes and the pubic portion of the fascia lata; externally by the femoral vein, and internally by Gimbernat's ligament.

The saphenous opening, by some named the "external femoral ring," is immediately covered by the deep layer of the superficial fascia, whose attachment to the lower margin of the opening is close and firm, while above it is relatively loose.

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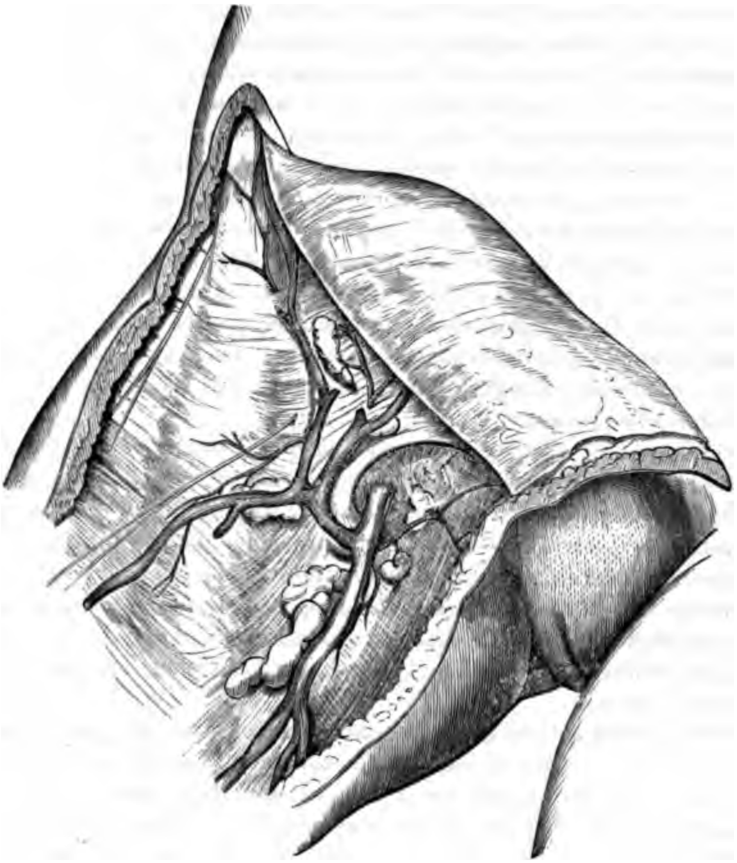
[1] Wherever the word "crural" has heretofore been employed by other writers I have substituted "femoral," for the sake of avoiding the confusion which might arise from the use of the two terms.

Fig. 372.



Superficial dissection of the anatomy concerned in Femoral Hernia. Gray.

It will now be easy to determine the natural course of a femoral hernia, and the nature and number of investments it must receive in its progress toward the surface. Entering the femoral ring, it will receive, first, the subserous tissue which here as elsewhere invests or underlies the peritonæum; second, the areolar tissue, etc., which closes the mouth of the femoral canal and sheath; third, the anterior wall of the femoral sheath. It is necessary here to explain, that by M. Velpeau the subserous tissue is named, both in its connection with inguinal and femoral herniæ, the "fascia propria;" by Sir Astley Cooper this term seems to have been applied to the union and condensation of the subserous tissue, the fascia cruralis, and the femoral sheath; while by other writers the same term is applied to the conjunction of the femoral sheath to the "cribriform fascia," or the deep layer of the fascia superficialis. For myself I would prefer to consider the whole as constituting a single fascia, to be called the fascia propria, since they are often thus consolidated and form together but one inseparable covering of exceeding tenuity; but I desire only to relieve this subject of the obscurity with which surgeons and anatomists have invested it. For this purpose it will be sufficient to adhere to the nomenclature of Sir Astley Cooper, and following, therefore, the course of the hernia, we shall reach the "fascia cribriformis," as the fourth in the order of the natural anatomical tissues, but as the second in the order of the true hernial pathology. Hitherto the course of the hernia has been downwards, with a slight inclination forwards and inwards; from this point its direction is suddenly changed, as it seeks to escape directly forwards through the saphenous opening; and owing to the firm attachment of the superficial fascia to the lower margin of this aperture, the hernia, having passed the saphenous opening, is driven upwards toward Poupart's ligament, across the inferior margin of the iliac portion of the fascia lata, called the falciform process.

The deep epigastric artery is situated to the outer side of the mouth of the hernia. In very rare instances the artery has been found upon the inner side; and still more frequently, the obturator having arisen from the epigastric, has crossed the upper boundary of the mouth of the sac, and coursed downwards upon the inner or pubic side toward the obturator foramen. At the saphenous opening the superficial epigastric, the circumflex iliac, and the superficial external pudic arteries lie, usually, below and outside of the line of incision, as does also the saphenous vein.

These herniæ are never congenital—that is to say, they are never due to congenital malformations, like the congenital herniæ of the inguinal region. They are of rare occurrence in early life, and, as has already been explained, they are much more common in women than in men. It is proper to mention, also, that the hernia does not always pursue the precise course which has been described. In a few cases it has been found behind the femoral vessels, or it has escaped through an aperture in Gimbernat's ligament. After reaching the cribriform fascia it may form itself into lobes by emerging at several points between the fasciculi of which the fascia is composed; or, having escaped from the saphenous opening, it may descend upon the front of the thigh.

Contents of Femoral Herniæ.—Femoral herniæ generally contain only intestine, yet it is not very uncommon to find the sac containing both intestine and omentum. Dr. Willard Parker, of this city, has reported a case in which the sac contained intestine, the ovary, and the fimbriated extremity of the Fallopian tube.[1] Examples are also recorded in which it contained the bladder, the uterus, the testicle, etc.[2]

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[1] Parker, *New York Medical Times*, 1855, p. 109.

[2] *Velpeau's Anat.* Amer. Ed., by Wood & Sons, 1830, vol. 2, p. 322.

Diagnosis.—A femoral hernia is liable to be confounded with an inguinal hernia, swelling of an absorbent gland, lumbar abscess, varix, and with fatty or other tumors.

From an inguinal hernia it may be distinguished sometimes by its history. It is not usually so large as an inguinal hernia; but in Ward 16, at Bellevue Hospital, there was, in the year 1869, a femoral hernia in a man, of the size of a child's head. If the tumor has ascended above Poupart's ligament, this ligament can still be felt by careful digital examination, situated above the tumor; it lies outside of the spine of the pubes, while an inguinal hernia is to the inner side; inguinal herniæ descend into the scrotum or labia, but femoral do not; if it is femoral, and in a male, the finger can be introduced into the unoccupied inguinal ring.

It is more difficult to distinguish this hernia from an enlarged absorbent gland; and here is where surgeons have most often fallen into error. In the paper on Hernia contained in the Bellevue Hospital Reports for 1870, already referred to, we have mentioned a case in which, being unable to make a positive diagnosis during several days, the delay in operating was the probable cause of death. Sir Astley Cooper mentions two fatal errors of this kind in his work on Hernia. Four cases are reported by Anderson in his treatise on the same subject, and many others have come to the knowledge of myself and of other surgeons. Indeed, nothing is more common than to be called in consultation when tumors in the groin have been under treatment for several days, which prove to be femoral herniæ, but which were supposed to be only adenoceles.

Treatment.—The treatment of a femoral hernia by trusses has been considered in the section devoted to general remarks. Very seldom have surgeons suggested or attempted to make the "radical operation" upon a femoral hernia. In making taxis, if the hernia has only partially escaped from the saphenous opening, its direction must be first backwards, and then upwards. If it has become reflected over the margin of the falciform ligament, the direction of the taxis must be first downwards, then backwards, and finally upwards.

It has been generally stated that the posture of the limb may obstruct or facilitate the reduction. This is true under certain conditions—namely, when the seat of stricture is at the saphenous opening, and is caused by the falciform ligament of the fascia lata. Flexing, adducting, and rotating the thigh inwards has a remarkable effect in relaxing this opening, and in increasing the capacity of the lower portion of the femoral canal; but when the stricture is at the femoral ring, the position of the limb neither diminishes nor increases the constriction I believe it was Anderson who first suggested that the explanation of this fact was to be found in the circumstance that Gimbernat's ligament is in a great degree independent of Poupart's ligament, and of the fascia lata, in consequence of certain tendinous fibres which arise from the anterior inferior spinous process of the ilium, coursing along the inferior margin of Poupart's ligament, forming with the latter only a feeble attachment—and which go at length to constitute the free concave border of the ligament called Gimbernat's. Other anatomists describe an "inferior crural" arch, but which they do not trace to the inferior spine of the ilium. My own dissections confirm Anderson's account of these tendinous bands, and afford a satisfactory explanation of the impossibility of relaxing this opening by a change of posture in the limb.

Elevating the whole lower portion of the body, as described heretofore, will sometimes accomplish the reduction when other means have failed.

Operation for Strangulated Femoral Hernia.—The patient being placed in the same position as in operating for strangulated inguinal hernia, an incision is made of sufficient length to expose the sac and the saphenous opening. In some cases it will be necessary to give to this incision a crucial form. The sac being reached, opened, and the contents examined, the surgeon will first ascertain whether the falciform ligament is the seat of stricture; and in case it is, nothing is more easy or more free from danger than to incise it where it is plainly exposed to view, nor do we think it material at what point, or in what direction, this incision is made. If the viscera cannot now be reduced, it only remains to carry the forefinger of the left hand to the femoral ring, feel for the sharp edge of Gimbernat's ligament, and with a probe-pointed bistoury laid flatwise, its edge directed toward the pubes and a little inclined upwards, press firmly against the ligament without any sawing motion, and the stricture will be divided.

Herniotomy, by release of the stricture outside of the sac, is probably more often applicable to femoral herniæ than to either of the forms of inguinal, inasmuch as a large number of these cases are strangulated by the falciform ligament or by the fibrous bands of the cribriform fascia, and the seat of stricture is therefore more accessible without incision of the sac than in most examples of inguinal hernia. If incision of these structures should fail, it is possible still that the neck of the condensed sheath, the fascia propria of Sir Astley, is the seat of the stricture; and, continuing the dissection until the sac is exposed, the knife may be introduced beneath the sheath and Gimbernat's ligament, and both may be divided at the same moment, as advised by Mr. Erichsen. This procedure will be facilitated by drawing down and compressing the neck of the sheath, and by insinuating the finger-nail under both the sheath and Gimbernat's ligament before the knife is introduced.

Umbilical Hernia. Syn., Hernia Umbilicalis, R. C.; Exomphalos; Omphalocele; Ruptured Navel.

Infantile Umbilical Hernia.—Umbilical hernia is occasionally present in a moderate degree at birth; and being concealed in a sort of funnel-shaped process, the depth of which is increased by drawing upon the cord, it has sometimes been included in the ligature applied by the accoucheur. It is much more common to meet with it as occurring a few days or weeks after birth. The umbilical hernia of infantile life seldom acquires great size, nor is it very liable to become strangulated.

If the hernia is small, a well-adjusted pad, supported by a broad, firm band of elastic cloth, or of adhesive plaster, will often suffice to retain it in place, and to effect a speedy and radical cure. In other cases, however, its persistence causes the sac to become adherent, and both its maintenance in place and its radical cure become much more difficult. Trusses or nipple-shaped metallic or gutta-percha compresses, such as have been recommended in the section devoted to general remarks on hernia, will now be required.

Umbilical Hernia of Adults.—When this form of hernia persists to advanced life, or occurs primarily at this period, it is a more serious and troublesome accident. It usually contains both omentum and intestine, and may attain great size. It is globular in form, but occasionally lobed, or divided into several tumors. The omentum is very apt to become adherent, and sometimes the intestine gets entangled in its folds, and ceases to be reducible; under which latter circumstances the intestinal canal is liable to obstructions, requiring great care and diligence for its relief. Rest in the supine position, moderate pressure, cold applications, gentle cathartics and enemata, are now the appropriate remedies.

If reducible, it must be maintained in place by an appropriate truss; and when irreducible it requires the support of a bandage, or concave pad.

Anatomy.—The hernia escapes either at the umbilical ring, or through one of the small apertures through which vessels are transmitted just above or below the umbilicus. The margins of the opening are sharp, tense, and unyielding, and cannot be affected materially by change of posture. In addition to the integument, the coverings are usually composed of the delicate internal abdominal fascia united to the fascia superficialis; to which are added, sometimes, a few tendinous fibres derived from the aponeurotic structure through which it has passed.

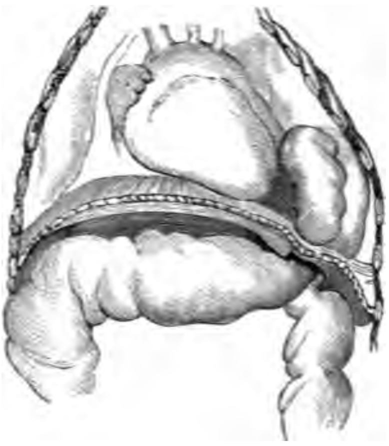
Operation for Strangulated Umbilical Hernia.—The statistics of this operation present a more unfavorable result than do the statistics of operations for either femoral or inguinal hernia. When it has been necessary to open the sac the result has generally been fatal It is advisable, therefore, always to attempt the reduction by division of the stricture outside of the sac; which method becomes the more appropriate in these cases because the seat of the stricture is seldom found in the sac itself. In order to accomplish this, the hernial protrusion must be depressed as much as possible toward the pubes; or it may be pushed upwards, in case the lower portion of the neck is found to be most accessible. An incision, two or three inches in length, must then be made in the median line; commencing one or two inches above the opening, extending downwards, and terminating a short distance upon the surface of the tumor.

This will bring into view, first, the tendinous fibres of the linea alba, from which, as a guide, the surgeon will be able to approach the margin of the aperture safely. When the aperture is reached and exposed, it should be lifted by a blunt hook and carefully cut. If this does not accomplish the release of the hernia, a search must be instituted to ascertain whether a second and more deeply embedded fibro-areolar band, caused by a splitting of the condensed fascia, is not the source of the constriction; or the cause of the strangulation may be sought for at some other point of the circumference of the neck. The operation will always be facilitated by drawing out the hernia while searching for the stricture. Only when all proper efforts to release the hernia by this method have been tried, will it be proper to open the sac.

Diaphragmatic Hernia. Syn., Hernia Diaphragmatica, R. C.

The abdominal viscera may press upwards and penetrate the diaphragm through one of its natural openings; through some point congenitally weak or deficient; through an aperture created by violence, as in the case of a penetrating wound, or a laceration caused by a great muscular effort, or by a crushing force. Its most frequent cause is congenital malformation or defect in the diaphragm, and this condition is found much more often in females than males.

Fig. 573.



Diaphragmatic Hernia.

The aperture of escape is usually upon the left side, sometimes median, and rarely on the right side. In three cases it has occurred on both sides simultaneously. The stomach and transverse colon, omentum, small intestines, spleen and liver are the viscera most often involved. They are seldom covered completely by peritonæum or pleura. The symptoms are displacement of the heart, and other thoracic viscera, as determined by auscultation and percussion, embarrassed respiration, constipation, vomiting, etc.

Prognosis.—Dr. Bowditch, of Boston, in a most exhaustive treatise upon this subject, has collated 88 cases. Of the congenital cases 11 died within two hours after birth, more than half survived one year, and 8 lived to adult age. In the accidental cases death generally took place within from one to seven days; in one case life was prolonged thirty-eight years, but not more than one in ten survived beyond one year.[1]

Treatment.—The patient should be placed in the erect position, or in such an attitude that the viscera will have a tendency to drag downwards toward the pelvis; and the bowels should be moved by stimulating enemata.

In every case upon record, in which a diaphragmatic hernia was strangulated, the patient has died. No operation has hitherto been made for its relief, but Dr. Bowditch has suggested that in certain cases it would seem possible that the knife might afford relief.

Epigastric Hernia. Syn., Hernia Epigastrica, R. C.

Richter denied the possibility of an epigastric hernia; but it is certain that it sometimes occurs, especially in the vicinity of the xiphoid cartilage, where the aponeurotic covering is thin. Lapeyronie was able to verify a case of this kind by an autopsy; and many other well-attested examples have been reported.

In some cases they seem to have emerged through the small apertures which exist for the transmission of blood-vessels, or which have been originally occupied by cellulo-adipose tissue. These latter, called "fatty herniæ," becoming extruded, draw after them a process of the peritonæum, and thus give rise to visceral herniæ.

Lumbar Hernia. Syn., Hernia Lumbaris, R. C.

Rare instances are recorded of herniæ which have made their escape at the anterior margin of the quadratus lumborum, near the point of its attachment to the crest of the ilium. It might, therefore, be confounded with a lumbar or psoas abscess which occasionally makes its exit at the same point. In one case, also, I have found an abscess, originating from disease of the sacro-iliac symphysis, presenting itself beneath the integument in this region, and which had pursued the same route.

In its course outwards this hernia passes in front of the quadratus lumborum, sacro-lumbalis, and latissimus dorsi; penetrating the fibres of the internal oblique and transversalis, which at this point are thin, and afford only a feeble obstruction to this natural outlet.

Obturator Hernia. Syn., Hernia Obturatoris, R. C.; Sub-pubic.

This hernia may occur in both sexes, but for anatomical reasons it is much the most common in women. The sac, composed of peritonæum, contains, usually, only intestine; but in one case the bladder, and in another case the ovary and Fallopian tube have been found in the sac Until recently the signs indicating an obturator hernia have been so little understood that in a majority of the cases its existence has not been determined until after death. We are chiefly indebted to the excellent paper written by Mr. Birkett, in Holmes' Surgery, for a thorough analysis of the cases reported, and for a well-arranged synopsis of the symptoms and treatment.

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[1] Diaphragmatic Hernia; a paper read before the Boston Soc. for Medical Observation, in 1847. Published in the *Buffalo Medical Journal*, June and July, 1853. By Henry I. Bowditch, Boston, Mass.

Anatomy.—The hernial protrusion takes place through the obturator canal or notch, at the upper and outer part of the obturator ligament or membrane; an opening which exists for the transmission of the obturator nerve, artery, and vein. It is therefore directly beneath the ramus of the pubes, and in close proximity to the head of the femur. It seldom attains a great size, the descent being almost immediately arrested by the external obturator muscle, or by its sheath.

The sac has been found lying between the muscle and the ligament on the one hand, and between the muscle and its fascia on the other; but in most cases it has pushed its way into the body of the muscle itself. In all cases the fundus of the sac is covered by the obturator fascia. The vessels and nerve have preserved no uniform relation to the hernial sac, being most often upon its inner or outer sides, but occasionally above or below. In a pretty large proportion of cases it has been observed that it was not an entire knuckle of intestine which occupied the sac, but only a portion of the diameter of the tube; but, in Mr. Hilton's case, the entire calibre of the ileum was found in the sac.

Symptoms.—A tumor is observed presenting itself in the groin, to the inner side of the femoral vessels, deeply seated among the adductor muscles, or upon the inner margin of Scarpa's triangle, less distinctly defined than is usual in femoral hernia, more removed from Poupart's ligament, and internal to the saphenous opening. This inspection will be made more readily if the thigh is rotated outwards, and slightly abducted. In case the tumor cannot be felt—as has happened in several of the examples reported—the diagnosis may possibly be made out by the pain caused by pressure at this point, or by rotating the thigh outwards; or, indeed, by the pain alone, which may exist independently of manipulation. The pain is described as extending down the inside of the thigh and leg to the great toe, in the course of the distribution of the obturator nerve, and especially of its cutaneous filaments; or as extending upwards into the muscles of the belly, through, perhaps, the nervous communications established by the lumbar plexus. The diagnosis may be aided, also, by the pain developed when pressure is made per vaginam, or per anum, upon the obturator canal. If to these signs we add colicky pains, nausea, vomiting, and the other usual signs of strangulation, with the negative evidence furnished by an exploration of all the other natural outlets of the belly where herniæ usually occur, the diagnosis may be considered as confirmed.

Treatment.—Dr. Roeser and others have succeeded in reducing this hernia by taxis, directed upwards and backwards. Dr. Obre was the first to treat successfully an obturator hernia by incision. His operation was made in 1851. Mr. Bransbey Cooper was equally successful in 1853.

The operation consists in making an incision nearly parallel to the inner margin of the adductor, commencing at a point over Poupart's ligament, about half-way between the spine of the pubes and the situation of the femoral vein, and terminating three or four inches below; exposing the pectineus muscle, whose fibres may be separated with the handle of the knife; and finally dividing the sheath of the external obturator, when the sac will be brought into view. Care must be taken to avoid the obturator nerve and vessels when the stricture is divided, and also while approaching the hernial sac.

Ischiatic Hernia. Syn., Hernia Ischyadica, R. C.

Sir Astley Cooper has carefully described a case of ischiatic hernia which occurred in the practice of Dr. Jones, and of which he was permitted to make a dissection. Death occurred, with the usual signs of strangulation. The autopsy disclosed the fact that the ilium, enclosed by the parietal peritonæum, had escaped through the ischiatic notch, between the sciatic nerve and gluteal artery, and in front of the pyriformis; the base of the sac reposing under the gluteus maximus

Pudendal Hernia. Syn., Hernia Pudendalis, R. C.

The term "pudendal hernia" has been applied to a visceral protrusion, occurring between the ascending ramus of the ischium and the walls of the vagina, forming, usually, a small, elastic tumor in the posterior part of one of the labia, having its long diameter parallel to the axis of the vagina. It is in most cases easily reduced, but returns quickly when the patient is in the erect or sitting posture.

A pudendal hernia may be confounded with a labial cyst, with varicose veins, or with an inguinal or a femoral hernia; but a careful examination of the tumor, its easy reduction, and the direction in which it retires, will generally leave no doubt as to its character. We have, however, met with one or two cases of encysted tumors in this region which were mistaken for pudendal hernia, and which had been treated by trusses.

Treatment.—The orifice through which the hernia escapes is usually large, and strangulation is not very likely to take place. It must be retained in place by a pad and bandage.

Vesico-Vaginal Hernia. Syn., Hernia Vesicæ in Vaginam, R. C.; Vaginal Cystocele.

In this form of vaginal hernia the anterior wall of the vagina, having become relaxed, suffers displacement, carrying with it a portion of the bladder and forming a tense, circumscribed tumor. In other cases the formation of the hernia is due to frequent and violent contractions or over-distention of the bladder. In either case, however, a permanent cul-de-sac or diverticulum is liable to be formed, communicating with the posterior wall of the bladder by a somewhat narrowed neck, which diverticulum, having lost in a measure its contractile power, is unable to expel its contents. After a time the retention and decomposition of the urine give rise to catarrhal inflammation of the mucous membrane, with all its train of evil consequences.

Treatment.—Vaginal supports, astringents, frequent evacuation of the bladder, aided by posture, are the principal or sole measures which can be expected to afford relief. Scanzoni recommends as a vaginal support the instrument devised by Roser, which is so constructed as to press the anterior wall toward the pubes and bladder.

Recto-vaginal Hernia. Syn., Hernia Recti in Vaginam, R. C.; Vaginal Rectocele.

The posterior wall of the vagina, in like manner as the anterior, may give way from relaxation, carrying with it the anterior wall of the rectum; or, on the other hand, from frequent and violent straining at stool, and from accumulation of hardened fæces, the rectum may become dilated in the direction of the vaginal space.

In addition to the inconvenience occasioned by the presence of this tumor between the labia, the patient sometimes suffers greatly from her inability to expel completely the contents of her bowels. The diverticulum is constantly filled with hardened fæces, causing tenesmus, mucous or bloody discharges, and sometimes hæmorrhoids.

Treatment.—Care must be taken that the bowels are kept constantly in a healthy condition, and all accumulations must be prevented by the use of lavements, followed by a small quantity of sweet oil. A truss or pad, applied firmly to the perinæum, will sometimes obviate the displacement, and give great comfort to the patient; but, in case this is not sufficient, it may be necessary to employ a vaginal support.

Entero-vaginal Hernia. Syn., Hernia Intestinæ in Vaginam, R. C.; Vaginal Enterocele.

When the recto-vaginal cul-de-sac gives way to the pressure of the abdominal viscera, the descent takes place from the upper and posterior portion of the vaginal space; and the involution may exist to such a degree as to constitute an almost complete inversion of the vaginal wall, causing a spherical or pyriform tumor, protruding even beyond the labia majora, in which the omentum, with coils of intestine, may be distinctly felt; when it has attained this size it is also resonant on percussion, and the diagnosis is not at all difficult, but at an earlier period it is not always easy to distinguish it from a descent of the fundus of the uterus. It is possible, moreover, to confound it with a varicose condition of the vaginal veins.

Treatment.—This hernia is always easily reduced and seldom or never suffers strangulation except during labor. For its retention, uterine and vaginal supports are required.

Perineal Hernia. Syn., Hernia Perinealis, R. C.

The name "perineal hernia" has been applied to that form in which the recto-vaginal cul-de-sac in the female, or its equivalent, the recto-cystic cul-de-sac in the male, lying between the prostate gland and rectum, is prolonged to the perinæum by the pressure of the viscera. In such cases a hernial protrusion may take place in the perinæum, or it may present itself in the female at the posterior commissure, projecting from between the labia.

Treatment.—A perineal pad, supported by a bandage, is all that can usually be of service.

Median Ventral Hernia. Syn., Hernia Ventralis in Media, R. C.

I have thought it proper to apply this term to a form of hernia usually included under the general title of "ventral." Two varieties have been observed by myself, which the following examples will illustrate:—

First, **Atrophy of the Rectus Abdominis.**—Mrs. A. E., æt. 30, was admitted to the Buffalo Hospital of the Sisters of Charity in Oct., 1850, laboring under cancer of the cervix uteri. Some years before she had given birth to two children; and a short time previous to admission she had fallen against the corner of a table, striking the belly, and causing a miscarriage. At the date of her entrance into my ward nothing unusual was observed in the form of her abdomen; but she began, subsequently, to emaciate, and about the first of January, 1851, the hernial protrusion commenced to appear; and for some time previous to her death, which took place in the following June, the protrusion was very marked. The uterus was not appreciably enlarged, nor was the abdomen tumid, but extending from the ensiform cartilage to the pubes there existed a broad projection of the abdominal wall, somewhat elliptical in form, but broader above than below, and corresponding to the outline of the recti muscles. The hernia disappeared when lying down, but reappeared when sitting or standing, and in this latter posture it occasioned so much inconvenience as to render it necessary for her to wear a broad band for its support. After death a careful dissection was made, and it was ascertained that the recti muscles had become wasted to such a degree that the muscular tissue could scarcely be recognized. The other abdominal muscles had suffered considerable atrophy also, but not to the same extent as the recti.

Second, **Laceration of the Linea Alba.**—Mrs. W., æt. 33, a large muscular woman, and mother of five children, consulted me seven weeks after the birth of the last child. The labor was not remarkably severe, and lasted only three hours; but when, on the third day, she sat up in bed, the hernial protrusion was discovered. When seen by myself, a hernia of an elliptical form, but not so broad in its centre as in the preceding case, extended from the ensiform cartilage to the pubes. The margins of the rent could be distinctly felt to be sharply defined on each border of the opening. She stated, upon further inquiry, that she was not unusually large prior to the confinement, and that she had no sensation of tearing during parturition.

In some of the recorded examples the accident has followed upon great and unusual abdominal distention, or upon very severe and protracted labor, and the patients have themselves been conscious of the sudden giving way of the parietes.

Treatment.—Bandages, or elastic abdominal supports, constitute the only sources of relief in either of the two preceding varieties of hernia.

Ventral Hernia. Syn., Hernia Ventralis, R. C.

This term is applied to all abdominal herniæ which do not occur at natural openings, or which are not included in the preceding nomenclature.

CHAPTER XV.

GENERAL SURGERY OF THE ABDOMEN.

Wounds of the Abdomen.

Incised or Lacerated Wounds of the Parietes of the Abdomen.—If the peritoneal cavity is not laid open, and there is no protrusion of the viscera, the treatment will be the same as that directed for other flesh wounds, in that portion of this treatise devoted to the consideration of wounds in general.

It is proper, however, to remind the surgeon that if the muscles are divided, there is a great probability that the patient may suffer thereafter from hernial protrusions, and for this reason it will be desirable to secure as complete and prompt union as possible. The wound should therefore be closed by sutures, and firmly supported by adhesive plasters and bandages. The sutures are in these cases rendered the more necessary, because adhesive plasters alone give a very inadequate support to the edges when, as in wounds of the belly, the underlying structures are movable, and afford little or no counter-support. Advantage should also be taken of posture, to relax the fibres of the several muscles, and to render their approximation more complete When union is accomplished, the patient must continue to wear a broad band until it is reasonable to suppose that a hernia will not occur.

In case the peritonæum is laid open and the viscera protrude, their condition must be observed; and if they are not wounded, they must be carefully returned. If the intestinal tube is found to have suffered lesion, it may require the application of sutures before its reduction, in accordance with the rules given when treating of gunshot wounds of the belly.

Punctured Wounds of the Belly.—Belly wounds, inflicted by pocket-knives and other small weapons,—of very frequent occurrence in civil practice,—and wounds inflicted by the bayonet in military practice, are in general more fatal than large incised or lacerated wounds. First, because a small piece of omentum, or of intestine, is apt to protrude and become strangulated; and, second, because the viscera are more liable to be wounded. Penetrating wounds inflicted by a sharp pocket-knife we have observed to be particularly fatal.

Treatment.—If none of the viscera have escaped through the orifice made by the weapon, the wound must be closed at once by adhesive plaster, compress, and bandage. Under no circumstances is it proper to explore the wound with the probe or with the finger. But in case any of the viscera protrude, and they have suffered no lesion, they must be promptly reduced; for which purpose it may become necessary to give the patient an anæsthetic, and enlarge the opening by incision.

When an intestine is wounded and thrust out of the cavity of the belly, the surgeon will be required to determine whether to employ sutures before the reduction of the viscus; or upon the propriety of reducing it, but with the margins of the visceral wound made fast by sutures to the parietal wound; or of leaving it where it is found. If the wound of the intestine is not more than two lines in length, it will, probably, be most safe to return it without a suture. If, however, the wound is from two to four lines in length, or larger, it should be stitched before reduction; and only when it is much torn, and the external wound partakes more of the nature of a lacerated wound—as, for example, in certain wounds made by the bayonet—will it be advisable to stitch the margins of the visceral wound to the parietal. A gangrenous condition of the protruding viscus would render it necessary to leave it where it is found. (See Gunshot Wounds of the Abdomen.)

Differential Diagnosis and Prognosis in Wounds of the Viscera.—The following summary of observations is all that is required in this connection:—

Wounds of the *stomach* are recognized by the depth and direction of the wound; by the vomiting of blood; by the discharge of the contents of the stomach externally through the wound; and by the great prostration of the system, caused by the injury. The prognosis is generally fatal.

Wounds of the *intestinal tube* may be known by the signs which indicate fæcal extravasations, and especially by the evacuation of blood. They are not so often fatal as wounds of the stomach.

A wound of the *liver*, unless quite small, is followed, generally, by the rapid escape of blood into the abdominal cavity; and its especial characteristic sign is, therefore, early syncope, or those general symptoms which indicate a loss of blood, and which can easily be distinguished from the symptoms of "shock." In some cases death ensues as speedily as if the heart had been opened. If life is prolonged a few days, there may be a discharge of bile from the wound, and the usual signs of hepatic inflammation.

Wounds or rupture of the *gall-bladder* are characterized by great pain, caused by the escape of the bile into the peritoneal cavity, and by prostration. Death results in nearly all cases within a few days, from peritonitis. A few examples of recovery, however, with a biliary fistula, have been recorded.

Wounds of the *spleen*, unless very superficial, cause speedy death by hæmorrhage.

Wounds of the *kidneys* are followed by bloody urine, urinary fistulæ, acute nephritis and suppuration. In most cases death has resulted in a few days; or in a few weeks at the longest.

Wounds of the *bladder* (see Gunshot Wounds and Wounds of the Genito-urinary Organs).

Fistula of the Stomach. Syn., Fistula Ventriculi, R. C.—A number of cases are upon record, in which patients have survived a fistula of the stomach for many years. Dr. Murchison has collected and published several of these examples, in connection with the report of a case which came under his own observation.[1] The principal inconvenience to which these patients are subjected is the constant escape of food, and the consequent inanition. The mucous membrane also, as in artificial anus, is liable to become protruded, especially when the lesion is near the pyloric extremity of the stomach.

Such fistulæ always evince a natural tendency to close, which must be encouraged by not permitting the pad, employed to prevent the escape of the contents, from pressing into the orifice. I am not aware that any one has succeeded in closing these fistulæ completely by a plastic operation; yet this procedure occasionally succeeds in cases of artificial anus, and might, no doubt, in these cases also.

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[1] *Holmes' Surgery*, Ed. of 1861, vol. ii., p. 452.

Fæcal Fistula. Syn., Fistula Stercorosa, R. C.—Surgical writers have, under the term "artificial anus," included the accident now under consideration, and also the artificial anus which is made for the relief of intestinal obstructions; a plan of nomenclature which is very confusing to the student, and for this reason I have thought proper to exclude the term as a synonym for a fæcal fistula, and to reserve it exclusively for the operation hereafter to be described.

There are two principal forms of fæcal fistulæ: one in which the side of the gut having been perforated, or having sloughed, the outer wall of the canal contracts adhesions to the internal parietes of the abdomen, and the inner wall remains in its normal position, so that the direction of the intestinal channel is the same as before the accident. To this class belong most of the fæcal fistulæ caused by gunshot, lacerated, incised, and penetrating wounds; and which, as we shall hereafter have occasion to see, usually get well spontaneously. In the second variety—the gut having given way at the most convex or projecting point of an intestinal fold or knuckle—adhesions of the outer wall have occurred in the same manner as in the first variety, but the inner wall remains folded upon itself, forming a septum between the two portions of the canal, and preventing the passage of the fæces from the upper to the lower; an arrangement which may be compared to the parallel tubes of a double-barrelled gun. The fæces are, in consequence, diverted toward the tegumentary opening incessantly and with force, rendering the case incurable so long as this condition remains. Those fæcal fistulæ which occur from sloughing of strangulated herniæ generally belong to this class.

Treatment.—A large proportion of the first variety—as will be seen by reference to what has been said in connection with gunshot wounds—get well spontaneously; or they demand for their cure only careful attention to the diet. In case, however, after the lapse of six months or a year, the cure is not accomplished, it may sometimes be effected by a plastic operation.

In the second variety it will be impossible that a cure should take place, until the direct course of the canal has been in some measure restored by the destruction or displacement of the intervening septum. For this purpose a great variety of tents have been employed, some of which were tubular, and, being made of materials which are innocuous, and which gradually soften and disappear with the alvine discharges, have been introduced into both the upper and lower orifices, and then shut in by a plastic operation. These devices have generally failed, and are no longer practised.

Dupuytren sought to destroy the septum by forcible pressure; and for this purpose he devised the instrument called the "enterotome," composed of a couple of steel forcep-like blades, which, being introduced into the canals, were made to compress the septum by the action of a screw. The instrument is cumbrous, and its use is attended with the danger of causing symptoms of strangulation and fatal peritonitis.

Dr. Physick, of Philadelphia, had in 1809, long before Dupuytren invented the enterotome, devised and practised a more rational operation. He passed a strong ligature through the septum, and tying it moderately tight upon the enclosed tissues, he permitted it to remain for a week. Adhesion being thus secured between the opposing peritoneal surfaces, he proceeded at once, and with entire safety, to cut away as much of the septum as he thought necessary. The fæces now resumed their natural course, and the cure was accomplished subsequently by the spontaneous closure of the external wound.

Abscesses of the Abdomen.

Abscess between the Muscles and other Structures composing the Abdominal Parietes.—*First, Anterior Parietes.*—It is very unusual to meet with abscesses in the anterior parietes of the belly, unless they have originated from purulent depots connected with some of the viscera; as, for example, from abscess of the liver, in connection with inflammation of the cæcum, appendix vermiformis, etc. Having their source within the abdominal parietes, we have seen them chiefly in syphilitic, scrofulous, and anæmic patients; and in such cases they are prone to form long and tortuous sinuses.

Second, Lateral and Posterior Parietes.—In the lumbar and iliac regions intermuscular abscesses are more common; yet even here they are sufficiently unfrequent to authorize a suspicion in all cases that they may have their source within the cavity of the thorax or abdomen, in some portion of the vertebral column, or in the pelvic bones.

Pus collects pretty frequently under the thick integument of the loins. Generally, as the result of some severe injury, the skin has been separated from the subjacent aponeurotic expansion of the latissimus dorsi, and a large *hæmatocele* is at first formed. After a time suppuration takes place in the sac, but the pus approaches the surface with difficulty, and, unless the abscess is opened early, it will descend and open spontaneously upon the sacrum, nates, or back of the thigh. Owing to the density of the sub-tegumentary areolar tissue along the spinous processes, it seldom crosses from one side to the other. It deserves to be mentioned that these sub-tegumentary hæmatoceles do not always suppurate, but occasionally result in the formation of serous cysts called *hygromata.*

Matter may form posterior to the central fold of the transversalis aponeurosis, as, for example, within the sheaths of the serratus posticus inferior and latissimus dorsi, or within the sheaths of the sacro-lumbalis, longissimus dorsi, and semispinalis dorsi; and in either of these cases the matter is pretty certain to evacuate itself beneath the integument posteriorly; while, on the other hand, if the matter collects anterior to the middle transversalis aponeurosis, within the sheath of the quadratus lumborum, it will easily penetrate the anterior fold and enter the abdominal cavity.

Psoitis and Psoas Abscess. Syn., Abscessus Psoadici, R.C.—As a result of inflammation of the psoas muscle, pus may form within its sheath, constituting a psoas abscess. This term has been employed, however, in a much more general sense, as indicating not only suppuration within the sheath of the psoas muscle, but also suppuration resulting from caries of the vertebræ; in which case the pus often enters the sheath of the psoas above, and by this route passes downwards to escape from the pelvic cavity. Finally, the term has been employed as synonymous with "lumbar abscess," and thus made to include all abscesses occurring in the deeper structures of the lumbar region.

In very many cases it is impossible to say where the abscess has originated, or to indicate, prior to death, its precise course. In others it is probable that the inflammatory and suppurative action pervades many structures at the same time; and in such cases no more exact term than lumbar abscess can be employed; yet there are not wanting examples in which the actual seat and course of the abscess may be positively affirmed.

Psoitis is the result, usually, of some violence done to the muscle, in which also the iliacus internus generally participates. Thus, for example, it has been caused by long races and forced marches; by leaping and vaulting. Professional "tumblers" often strain these muscles when standing upon the feet and hands with the body curved forwards. Men engaged in the lumber trade, and especially in rafting, are peculiarly liable to psoitis. It may be caused, also, by the pressure of the head of the child in parturition when the psoas encroaches upon the bis-iliac diameter of the pelvis.

The accession of inflammation is indicated by pain in the lumbar region extending down the thigh, pain and retraction of the testicles, inability to stand for any length of time, and relief of the sense of discomfort when lying or even sitting with the thighs flexed. When pus forms, it follows, in a certain proportion of cases, the course of the muscle until it has escaped from underneath Poupart's ligament. This commonly takes place on the outer or iliac side of the muscle; when it may point anywhere in the thigh, but usually on the inner and middle or upper portions. In other cases the pus escapes from the sheath of the psoas muscle near the junction of that muscle with the iliacus internus; at which point, in the direction of the integument, the fascia is thin, and it makes its way to the surface along the outer margin of the quadratus lumborum and over the crest of the ilium, or parallel to Poupart's ligament; or, breaking through the psoas fascia at some other point, the abscess pours its contents into the loose sub-peritoneal areolar tissue, and now it may reach the surface through a variety of natural outlets.

When a psoas abscess of purely traumatic origin, uncomplicated with caries of the spine or with other grave lesions, reaches the surface by its most direct routes, the prognosis is favorable. I could cite a number of cases in confirmation of this statement.

Vertebral Abscesses.—By this term I designate those abscesses resulting from inflammation of the vertebral and intervertebral structures —arthro-chondritis—usually accompanied with caries of the vertebræ, and with softening and ulceration of the intermediate fibro-cartilaginous tissues. They have been heretofore denominated "psoas" or "lumbar" abscesses. The reasons which have led to this substitution of terms have already been given.

Arthro-chondritis, or inflammation of the vertebral column, is most frequently observed during the period of infancy, or very soon after the child begins to walk, but it may occur at any period of life. Children of a strumous or tuberculous diathesis are especially liable to this affection; but a careful inquiry will generally disclose the fact that some direct injury was the immediate or exciting cause. It is not proposed in this place to enter into a consideration of spinal caries, but to refer to it only as the most common source of vertebral abscesses.

Vertebral abscesses may originate at any part of the vertebral column; but the liability diminishes as we proceed from the lumbar vertebræ toward the occipital bone. They are characterized by those signs which indicate inflammation, softening and caries of vertebræ, namely, localized pain, tenderness, and angular projection of the spinous processes; to which will be added those general disturbances which accompany the formation of pus, such as irregular chills, fever, etc., and finally pointing of the matter toward the surface. It seems proper to say, incidentally, that arthro-chondritis, softening and angular distortion of the spine, do not always imply either caries or suppuration. We often meet with cases in which complete recovery, with permanent spinal deformity, but without the evacuation of pus, indicates clearly that neither caries nor suppuration has ever taken place. Some pathologists have thought that in these examples pus has been formed and subsequently absorbed; but they have furnished no proof of the soundness of their opinions, and we see no reason for their acceptance. A better explanation is furnished in the supposition that softening, interstitial absorption, and consequent atrophy of the bodies have caused the dorsal projections.

When caries takes place in the upper cervical vertebræ, the pus usually presses towards the back of the pharynx, forming a *post-pharyngeal abscess;* or it may fall downwards between the vertebræ and œsophagus, and finally enter the posterior mediastinal space. Matter resulting from caries of the lower cervical and of the dorsal vertebræ usually follows the same course, descending along the posterior mediastinal space, passing under the ligamentum arcuatum internum, entering between the fibres and within the sheath of the psoas muscle, sometimes bifurcating above the diaphragm to pass upon each side of the spinal column, and making its final exit from the body in the same direction as a psoas abscess. Occasionally a dorsal vertebral abscess opens upon the back, three or four inches to the one side or the other of the spinal column, between the trapezius and latissimus dorsi. Pyothorax sometimes points in the same direction. Both cervical and dorsal abscesses may open into the cavity of the thorax.

The psoæ muscles have their origin from the sides and transverse processes of the bodies of the last dorsal and four upper lumbar vertebræ, and when either one of these vertebræ is the seat of caries, the matter infiltrates between the muscular fibres within the sheath, causing, sometimes, almost complete atrophy or destruction of the muscular tissue, and finally escapes from the cavity of the belly by the same outlets as the psoas abscess which results from psoitis.

Caries of the Last Lumbar Vertebra, and Suppurative Disease of the Sacro-iliac Junction.—We have in several instances found abscesses originating from these sources evacuate themselves in front of the quadratus lumborum, above the crest of the ilium. Either of them, however, may find other routes within or without the pelvic cavity.

Cervical, dorsal, and lumbar abscesses, depending upon caries of the bodies of the vertebræ, are in most cases fatal. In a few exceptional examples, after the evacuation of the pus, and a protracted continuance of the discharge, the vertebral structures resume a healthy action, bony splints are formed, and recovery takes place with permanent deformity of the spine.

In a few cases caries of the oblique and transverse processes has been found, but always connected with disease of the bodies. It is possible, however, that in some instances an abscess may have its source in a diseased condition of one of these processes; and especially would it seem possible that it might occur in connection with ulceration of the articulating surfaces of the oblique processes; but I do not know that any example of this kind has ever been recorded.

Abscesses originate occasionally within the sub-peritoneal areolar tissue as a consequence of peritonitis, enteritis, metritis, and ovaritis; or as metastatic collections, or in connection with pyæmia; but in most cases the pus, having formed originally in the pleural or abdominal cavity, in the structure of the enclosed viscera, in the fleshy parietes, in connection with disease of the vertebræ, or of the sacro-iliac junction, or from suppurative inflammation of the psoas muscle, has subsequently broken through into this loose, abundant, and widely disseminated structure. From whatever source derived, a purulent collection within the sub-peritoneal areolar tissue may discharge itself over the brim of the pelvis, along the inguinal canal, beneath Poupart's ligament, at the obturator foramen, through the ischiatic notch, into the bladder and intestinal canal, beside the rectum, or into the vagina. I have myself o expand its walls above and latterly, while its prolongation beneath the integument external to the abdominal cavity is a matter of comparatively little moment.

Whenever the time arrives at which the evacuation of the pus seems to be proper, or inevitable, it is better, in my opinion, to accomplish this slowly by repeated small punctures, which may be left open or only covered and supported by a compress and bandage. This is in some measure an imitation of the natural process of evacuation, and, I believe, it is usually followed by less intense febrile disturbance. Probes, tents, and injections are never admissible until the abscess has been opened several weeks. Indeed, I have never seen any benefit from either tents or injections at any period of the progress of this class of purulent collections.

Abscess of the Liver. Syn., Abscessus Jecinoris, R. C.—Abscess of the liver may occur as a consequence of pyæmia, as a result of various affections of the alimentary canal, especially of dysentery, of acute nflammation of the liver, and from various other causes.

Hepatic abscesses are much more frequent in warm climates than in cold or temperate regions; and at present our largest amount of experience and statistical information is derived from those medical gentlemen who have practised in the East Indies and Egypt. The Medico-Surgical Society of Alexandria published, a few years since, the conclusions derived from a discussion upon this subject, including a report of 123 cases, of whom 79 died, and in 9 the results were not ascertained. Of the whole number, 81 were not operated upon; and it was observed that if the abscess opened into the peritonæum, pleura, pericardium, stomach or intestines, or anywhere except into the lungs, the result was generally fatal. The total mortality in the cases not operated upon was 80 per cent. 42 cases were operated upon, with a mortality of only 50 per cent.; but a subdivision of this group into small and large abscesses gave a still more interesting result. In 10 cases of abscesses smaller than a man's fist the mortality after the operation was reduced to 30 per cent., while the mortality after operation in the case of abscesses of the size of a man's fist, or larger, was 68.18 per cent.

The conclusions reached, therefore, were, that it was better to open those abscesses than to leave them to open spontaneously; and that the earlier the operation was made the greater would be the chance of recovery.[1]

Dr. W. Stewart, who has had a large experience in India, observes also that hepatic abscesses evacuating themselves by the lungs not unfrequently terminate in recovery; but when in any other direction, whether by the aid of the knife or spontaneously, they have all, so far as his experience extends, terminated fatally.[2]

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[1] *The Medical Record*, Sept., 1868, copied from the publication of the Alexandria Medico-Surgical Society.

[2] *Ibid.*, June 4, '870, p. 12.

Unfortunately we have no means of determining the course of the matter in one direction or the other. If the abscess forms near the convex surface there is a chance that it may make its way into the lungs; if, however, the matter collects near the concave surface it is more liable to open into the stomach or intestinal tube, and it is only when the pointing is toward the anterior and superior margins that it is likely to reach the surface.

These abscesses ought never to be opened unless they point distinctly toward the surface, nor until sufficient time has elapsed for the peritoneal surfaces to have become adherent. If this rule is not observed, the pus will be evacuated into the peritoneal cavity and the patient will die in consequence. Many years ago a surgeon whom I met in consultation decided, against my protest, to operate when the conditions named did not obtain. The abscess was reached, but about one-half of the pus entered the peritoneal sac, and the patient survived only a few hours. Some recent observations would seem to show that aspiration could be practised with less risk than the open, free incision; but it is difficult to understand how the partial evacuation thus obtained could effect a cure.

In several instances I have seen these collections reach the surface with safety, the openings being usually formed between the ribs, near the lower margin of the chest; and these patients have generally, after many months or years, made a complete recovery.

Tumors of the Abdomen.

We do not very often meet with tumors connected with the anterior parietes of the abdomen; but upon the back, both in the dorsal and lumbar regions, they are of frequent occurrence. In most cases these growths are *adipose;* occasionally they are *encysted*, containing serum, sebaceous matter, or blood—*hæmatoceles; bursæ* sometimes form over projecting spines and at the inferior angle of the scapula. The other varieties of tumors are very seldom seen upon the back.

Adipose tumors occurring upon the front of the belly are sometimes attached to the peritonæum, consituting the *hernies graisseuses* of the French; and as this fact cannot always be known, it may be considered a good rule not to interfere with them, unless they cause considerable inconvenience. Adipose tumors of the back, when developed beneath the muscular or tendinous expansions, assume a flattened form, and may be mistaken for abscesses. When superficial they are more prominent, but seldom pedunculated. Subcutaneous adipose tumors are often migratory. I have seen one example of an adipose tumor in this region which travelled from near the angle of the scapula to the nates, and another which travelled from the neck to the loins in the course of a few years.

Intra-parietal abdominal tumors form a very numerous and interesting class, often exceedingly difficult of diagnosis, and still more difficult of cure. Abdominal tumors, or swellings which bear a resemblance tumors, may be occasioned by the various forms of enlargement of he liver, such as simple hypertrophy, hypertrophy from fatty degenera- ion, tumefaction from retention of bile; by scirrhus, encephaloid, or elanosis of the liver; by watery, encysted, and hydatid tumors; by bscess of the liver, or displacement from pyothorax; by dilatation or scess of the gall-bladder; by enlargement, tumors, or abscess of the leen; by tumors or displacement of the kidneys; by exostoses, enchon- omata, or malignant growths from the pelvic bones; by hypertrophy mesenteric glands; by aneurisms; by peritoneal sacs containing cal- li;[1] by ovarian cysts and solid malignant or non-malignant growths of e ovaria and broad ligaments; by fibroid and other uterine tumors; enlargements of the prostate gland; by various abscesses, herniæ, cal obstructions and accumulations; and even by flatus, the last giv- g rise to the so-called "phantom-tumor."

M. Nélaton has described a fibroid tumor which occurs pretty fre- ently, according to his observations, in the iliac region, having, in all ses, a pedicle by which it is attached to the concave surface of the um, near its anterior superior process. M. Nélaton has seen fifteen ses, all of which occurred in women who had borne children. They y be removed by incision without entering the cavity of the peri- æum; and when removed they have not returned.[2]

Cystic Tumors of the Liver present two varieties. First, the *nple serous*, or *watery cyst*, described by Mr. Brodie, and observed Drs. Bristowe and Wilks to coexist frequently with cystic degenera- n of the kidneys.[3] Second, the *hydatid cyst*, or *acephalo-cyst hydatid*, a compound and proliferating nature, and containing the parasite lled *echinococcus*.[4] We have no means of recognizing these cysts en they are small; but when they have attained considerable size they y pass, by perforation, into the alimentary canal and be detected in the acuations. They form, sometimes, very large tumors, and may at rious periods of their growth be confounded with an abscess of the er, encephaloid of the liver, or with dilatation of the gall-bladder. e essential points in the differential diagnosis are, the absence, in st cases, of pain, tenderness, or other signs of hepatic disturbance. t the symptoms which have been considered most pathognomonic e the musical note observed by Rayer and Briançon on percussion; d, added to fluctuation,—which is common to this and to other cavities ntaining a thin fluid,—a peculiar vibration. In a case reported by s. Keyes and Van Buren these signs were not present, and the diag- sis was not made out until the cysts were evacuated by the bowels.[5] periments made by Briançon seem to show that the absence of the suddenly increased by the removal of the pressure, and the consequent abstraction of blood from the brain and other vital organs sometimes causes syncope. The point usually selected for the operation is the median line, through the tendinous structure of the linea alba, perhaps about midway between the umbilicus and the pubes. The surgeon may, however, select any point in this line, provided it is not lower than within three inches of the pubes. I have several times, when the umbilicus has been found distended by the fluid, and projecting, operated at this point, which possesses the advantage of not being covered by fat, and of presenting no tendinous structure through which the trocar must pass. The higher the puncture is made, the greater will be the danger of wounding the omentum or intestine. Operators have occasionally opened through an old hernial sac, from which the viscera have retired, and which is now distended with serum.

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[1] *Trans. Lon. Path. Soc.*, vol. vi., p. 204; vol. xii., p. 89.

[2] Nélaton, *Chir. Path.*, vol. iv., p. 394.

[3] *Trans. Lond. Path. Soc.*, vols. vii. and x.

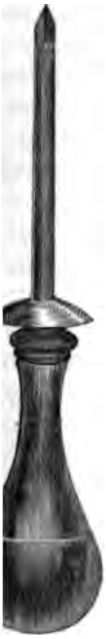
[4] (*Found also occasionally in other organs.*)

[5] Keyes and Van Buren. *The Med. Record*, Jan. 1, 1869

I wish to suggest to the surgeon the propriety of marking the spot upon the linea alba, with ink or the tincture of iodine, where it is proposed to cut, while the patient is lying upon the back, and before the bandage is applied; since, when the belly is thus enormously distended, and after the bandage is applied, especially when the patient lies upon one side, it is very difficult to determine the situation of the linea alba; indeed, it is quite possible to go several inches astray to the one side or the other, and to wound the internal epigastric artery. This accident has happened to me. A woman upon whom I operated for ascites was reposing upon her side, and, after adjusting the bandage, an opening was made through it, and the belly tapped, as was supposed, in the linea alba; the serum escaped freely, until the evacuation was complete, and not a drop of blood had been seen either upon the surface, or mingled with the serum; but when the trocar was nearly withdrawn, its distal extremity having escaped from the cavity of the peritonæum, but still remaining beneath the skin, a stream of arterial blood, nearly filling the canula, flowed from its open extremity. Alarmed, and uncertain how to proceed, I permitted the canula to remain in this position until nearly a pint of blood had escaped, thinking it better that it should flow outwardly than inwardly, and hoping that it would cease spontaneously. In this I was disappointed; and, finally, I thrust the canula farther in, and the bleeding at once ceased. Preparing then a graduated compress, the trocar was again slowly withdrawn, and, arresting its extremity where it had been arrested before, the pheuomenon was repeated—the blood flowed in a full stream. Removing it entirely, blood continued to trickle quite freely over the skin. The compress and a firm bandage were then applied, and the bleeding ceased altogether. The recovery was as complete and rapid as usual in such cases; and, several months later, having occasion to tap her again, I discovered that my first operation was made three or four inches to the right of the median line; and in the character of the serum which aped, I found evidence that there had been no internal hæmorrhage er the first operation.[1]

If the person is very fat, it will be advisable to make an incision ough the integument, until the tendinous structure is seen, before introducing the trocar; but not without reflecting how very much attenuated this structure becomes in old cases of dropsy, so that, unless careful notice is taken of the tissues, the peritonæum may be unexpectedly exposed. In thin persons, and in those of ordinary fatness, it is better to use the trocar and canula alone.

Fig. 375.

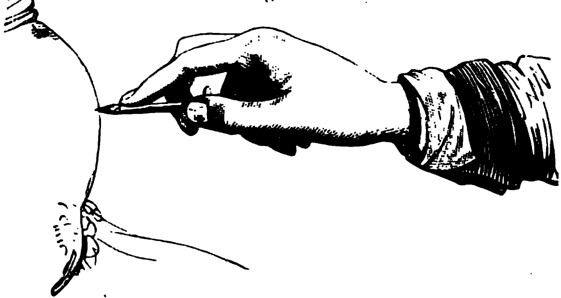


r and Canula.

As soon as the point of the trocar has fairly entered the cavity, the canula must be thrust steadily forward to its hilt, and the trocar at the same moment withdrawn. Occasionally the orifice becomes obstructed by the omentum, and it should be then held away by a blunt probe, or, as is better, by a flexible catheter passed through the canula. Care must be taken not to admit air, and this is most effectually accomplished by rolling the patient more towards the front of the belly as the fluid escapes, and by withdrawing the canula when the serum no longer flows freely, for it is wholly unnecessary to evacuate every pint of the fluid.

When the operation is completed, a small pad, secured by adhesive plaster, must be laid over the wound, and the patient must then be laid upon his back, his belly well supported by bandages, and not permitted to rise, or even to occupy the sitting posture for twenty-four hours. This latter injunction is enforced by the following untunate case, related to me by Dr. W. W. Reid, the gentleman whose ne is so intimately connected with the method of reduction of the -joint by manipulation, and who has requested of me that I would e the case all the publicity I could, as an admonition to other erators.

Fig. 376.



Operation of Paracentesis Abdominis.

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[1] This case is incorrectly reported in my Treatise on Military Surgery, the case here reported having been written without the notes before me.

Dr. R. tapped Mrs. H. in Nov., 1844, while she was in the sitting posture, removing fourteen quarts of serum from the peritoneal cavity. She was supported by a bandage, and this was tightened as the size of the abdomen was diminished, but about the time the evacuation was completed she was seized with difficult respiration and a convulsive cough, which was relieved by pressing very firmly up under the ribs toward the diaphragm. It was also relieved completely the moment she was laid down. The symptoms were so unusual and alarming that instructions were left by Dr. Reid when he left the house that she should not be raised in bed or moved until he returned. Six hours after the operation she was lifted by her attendants to remove her wet clothes, and was immediately seized with the same cough and difficulty in breathing as before. She was again laid upon the bed, but the symptoms were not changed by the change of posture, and in about two hours, before the arrival of the doctor, she died. Her death seemed to have been caused by suffocation, or inability to inspire, and not by syncope. No autopsy was allowed.

Obstructions of the Alimentary Canal.

Internal Strangulated Hernia. Syn., Strangulatio Interna, R. C.—A portion of intestine may pass through a natural or abnormal opening of the mesentery, meso-colon, or omentum, and become at once strangulated; or the strangulation may be caused by adventitious bands, the product of some previous inflammation.

In either case the general symptoms are the same as in strangulated external hernia; the local signs are pain and tenderness, which may be more or less circumscribed; and tumefaction, due to the accumulation of the contents of the bowel above the point of stricture.

These accidents have seldom been recognized during life, except where they have occurred after the reduction of an external hernia; and with this exception, therefore, they will rarely be subjected to a surgical operation. The operation, if made, consists in laying open the walls of the abdomen opposite the seat of stricture, in case the exact seat of stricture can be determined; or, in case it cannot be determined, in making an incision in the median line, along the linea alba. The subsequent steps of the operation can only be determined by the peculiar anatomical characters of the case. Nearly all of the remaining intestinal obstructions occur chiefly below the ileum, in the colon or rectum.

Intussusception. Syn., Intestina in se Suscepta, R. C.; Invagination of the Intestine.—Invagination consists in the descent of the upper portions of the intestinal tube into the lower. It is a very common thing to find, in the post-mortem examinations of children and infants, an invagination of the small intestines at one or more points, especially in the lower portions of the jejunum and upper portions of the ileum, but which gave rise to no obstructions or other symptoms during life. It is possible, indeed, that most or all of these invaginations occurred in the act of death. Most writers have denied that intussusception causing obstruction ever takes place in the small intestines, and it is certainly exceedingly rare; but Dr. J. Lewis Smith, of this city, who has investigated this subject very thoroughly, has reported two examples of fatal intussusception of the small intestines.[1]

Invagination causing obstruction may occur at any point of the large intestine, but its most frequent seat is at the ileo-cæcal aperture; the ileum being projected through this opening, which latter soon acts as a sphincter upon the protruding mass and causes strangulation; or, if the aperture yields to the pressure and dilates, the intestine may continue to descend, dragging with it the mesentery, until it has traversed the entire length of the large intestine and presents itself beyond the anus. Dr. Smith relates a case quoted from Dr. Jones, in which a child, four months old, lived six weeks after the invagination commenced, and seventeen days after the ileum had protruded at the anus.

Next in point of frequency the invagination commences at the caput coli, drawing down with it the ileum and successive portions of the colon in the progress of the involution, until at length, as in the case reported by Dr. Worthington, it escapes from the rectum. In both of these forms of extreme invagination the canal may remain in some degree open, the fæces being discharged externally, directly from the ileo-cæcal aperture. Many of these cases occur without any previous intestinal disorder, but the majority have been preceded by diarrhœa, dysentery, or constipation.

Symptoms of Intussusception.—Pain and tenderness in the course of the large intestines, sometimes a palpable tumefaction, nausea and vomiting, accompanied by constipation, constitute the usual signs when strangulation exists. In the case of infants there is also added, in most cases, small, muco-sanguinolent stools with tenesmus; or in extreme cases of involution, with only moderate strangulation, there may exist protrusion of the gut through the anus, and the presence of the ileo-cæcal valve may be demonstrated. In some cases an examination *per anum* may disclose the character of the malady. It has been observed in all these cases that injections are speedily expelled.

Prognosis.—Intussusception in infancy or childhood is generally fatal; a large proportion dying, when strangulation is acute, on the third day, and very few surviving one week. Nevertheless, a few are known to recover; some by a spontaneous evolution of the invaginated gut, some by the sloughing off of the portion strangulated and its expulsion by the rectum; and others under the use of judicious remedies.

Treatment.—Cathartics are inadmissible; opiates in moderate quantities are useful to allay spasm and pain; but large injections of air in use for this malady since the days of Hippocrates, have always been found most effective. Large injections of water or of oil have the disadvantage of weight, and cannot well be substituted for air alone. For this purpose we may employ a pair of ordinary bellows, a stomach-pump with closely-fitting and well-oiled piston and valves, or a large India-rubber bladder fitted to a tube and supplied with a stop-cock.

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[1] *Treatise on Diseases of Infancy and Childhood*, by J. Lewis Smith, M.D., Phys. to Infants' Hospital; Professor in Bellevue Hosp. Med. Col. 1869. H. C. Lea: Philadelphia.

Surgical Operation.—It is said that in the adult a successful operation has been made for the relief of the malady by incision through the abdominal walls; and it is certainly only in adults that such a procedure could encourage any hope of success. Surgeons have with great uniformity condemned the knife as unworthy of a trial when either children or infants were the subjects of these accidents. In case the operation were to be attempted, the incision should be made in the median line, along the linea alba; and all those precautions should be taken which are usually practised in the operation of ovariotomy.

Volvulus (*Syn.* Ileus, from *ειλεός*, I twist), or a twisting of the intestine, including the mesentery, or of the meso-colon upon itself, in consequence of which the intestines become knotted and obstructed, is a condition known to produce fatal strangulation; but our means of exact diagnosis are so imperfect during life that it does not seem to require any further notice. It is enough that its symptoms imply acute obstruction and perhaps strangulation, and this might in some cases be all that it was required to know to justify an operation.

Dr. Busch has cured, what he believed to be cases of both ileus and intussusception, by prolonged massage, or by pressing backwards and forwards upon the ends of the tumors. It is not improbable that elevating the body of the heels might occasionally accomplish the same purpose.

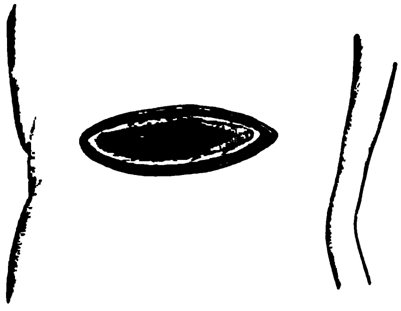
Making an Artificial Anus.

Chronic obstructions of the intestinal tube may be caused by the pressure of tumors or of aneurisms, by scirrhus and epithelioma of the rectum, by syphilitic and other rectal strictures, by congenital occlusion of the rectum, and in various other ways. Most of these abnormal or pathological conditions are known to occur chiefly in the lower portion of the sigmoid flexure or in the rectum; some of them limit themselves exclusively to these regions. It is for this reason more than for any other that the operation for artificial anus has been usually made in the descending colon, or in the upper portion of the sigmoid flexure; but an additional reason for preferring this point has been found in the fact that here, especially in the case of the adult, the intestinal canal may be reached without penetrating the cavity of the peritonæum. On the right side, the cæcum and a portion of the ascending colon present the same anatomical advantages, and have therefore been occasionally selected for similar operations.

Operation.—The operation which ought to be preferred in the adult is that first made by Amussat in 1839, and which has to-day been repeated many times with what has been regarded as encouraging success.

The following is his method:—A transverse incision is made upon the left side parallel to, and about two fingers' breadth above the crest of the ilium, and four inches in length; the centre of which will correspond to the centre of the crest. Continuing to divide the tissues in this direction, portions of the fibres of the latissimus dorsi, quadratus lumborum, obliquus externus and internus, and the transversalis will be successively exposed and cut; or the line of the incision may be kept to the outer side of the quadratus lumborum, so that its sheath only will be exposed, and its muscular fibres not cut. Cellulo-adipose tissue of more or less abundance will now be brought into view, beneath which lies the colon; which last may be recognized by its hardness and by its bulging, if filled with fæces, and by its greenish color. The intestine being well exposed, is seized by a tenaculum, or with a strong ligature, and held until it is opened by a knife or large trocar and canula. If the wound is deep, care must be taken in emptying the gut that its contents do not escape among the adjacent tissues, or along the track of the wound. The operation is now completed by stitching the margins of the intestinal wound to the integument, and for this purpose it must be drawn well out. After the operation the patient should repose upon the wounded side to facilitate the escape of the contents of the bowels. If it is desired to render the canal fistulous and permanent, a large silver, ivory, or flexible tube may be subsequently introduced, furnished with a shield to prevent its escape inwards, and a stop-cock to control the fæcal evacuations, or the open mouth of the tube may be kept closed with a cork or India-rubber pad, supported by a bandage.

Fig. 377.



Amussat's Operation.

In operating upon infants with congenital occlusion of the rectum, it will be remembered that the kidneys are at this period of life large and extend outwards to near the line of incision; that they are covered with very little fat; and that the meso-colon descends lower upon the colon than in adult life. Some have, for these and other reasons, preferred in such cases Littre's operation, which consists in cutting from the left iliac region directly through the peritonæum and upon the sigmoid flexure. This was the method adopted by my friend Dr. Pooley, of Yonkers, in a case of congenital occlusion of the rectum. The operation was completely successful, and at the end of a year the child was in good health.[1]

The vessels liable to be cut in this operation, whether made according to Amussat's or Littre's method, are small, and will be easily secured by the forceps and ligature.

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[1] Pooley, *Amer. Jour. of Obstetrics, etc.*, May, 1870.

It seems necessary to state further, in regard to the operation of colotomy, in whatever manner performed, that although nearly one-half of the patients upon whom it is made have survived a sufficient length of time to render it certain that it is a proper surgical expedient where the purpose is solely to prolong life; yet it cannot be denied that it seldom, if ever, results in a permanent cure by the restoration of the natural or original channel.

Gastrotomy.—There are several conditions under which the operation of laying open the walls of the abdomen and incising the stomach has been practised: first, in examples of stricture and complete closure of the œsophagus in its lower portion, and in order to establish a fistulous opening through which nourishment may be conveyed into the stomach (see Stricture of Œsophagus). This operation has also received the name of gastrostomy—a mouth in the belly—when performed for the purpose now indicated. Second, gastrotomy has been performed for the removal of foreign bodies from the stomach; third, for the purpose of dilating a stricture of the pyloric orifice of the stomach; and fourth, for extirpation of cancer of the stomach.

In the first of these classes, according to Agnew, ten out of the eleven cases reported seem to have had their lives shortened by the operation; in one the result is not known.

When gastrotomy has been performed for the removal of foreign bodies, the success of the operation has been more satisfactory. Of eleven reported examples, all except one have recovered.

As a means of enabling the surgeon to dilate, by the finger or otherwise, a stricture of the pylorus, it is in my opinion not entitled to one moment's consideration.

Finally, when made for the purpose of removing a portion of a cancerous stomach, it is simply an ante-mortem dissection, and has no proper place in surgery.

Both of these latter statements are made after a study of the reported cases, and with a just appreciation, I hope, of my responsibility to suffering humanity. In neither case can there be anything more than an approximate knowledge of the actual pathological condition and complications, and in neither case can anything but temporary relief be afforded, and that at the imminent risk of immediate death, or of death resulting directly from the operation.

Lesions of, and Operations upon the Gall Bladder.

Abscess of the Gall Bladder.—In consequence of the presence of gall-stones, or of blows received directly upon this viscus, giving rise to a cholecystitis, suppuration occasionally takes place in its interior; the matter sometimes making its way into the intestines, and at others approaching the tegumentary surface either directly, or at some depending and, occasionally, quite remote point.

In case the abscess points toward the surface, it should be opened and evacuated as soon as a reasonable presumption exists that the overlying peritoneal surfaces have become adherent.

Fistula of the Gall Bladder.—If, in consequence of the spontaneous or artificial opening of the gall bladder, a fistula becomes established, and if, after the lapse of several months, the bile continues to escape freely through the fistulous canal, and its absence from the intestines is indicated by the color of the fæcal evacuations, it will be proper, if practicable, to explore the gall bladder with a probe, in order to determine whether it contains calculi, and which may be the cause of the obstruction at the natural outlet, and to remove them in case they be found.

In most cases the causes of obstruction will be found to be beyond detection, and their removal beyond the skill of the surgeon; and the patient will have to submit thereafter to the permanent annoyance of a biliary fistula; a destiny which is not usually so deplorable as some physiologists have taught us to consider it, since experience has shown that these patients suffer but little, if at all, in their digestion, or in the healthy performance of any of the other functions of their body. The correctness of this statement I have seen verified in several examples, and other surgeons have made the same observation. It is probable, therefore, that the bile is only an "excretion," or that, if it performs any function in the digestion and assimilation of food, it is not a very important function, and not one which cannot be supplemented by other glands.

Cholecystotomy, or incision of the gall bladder, has been occasionally practised for the purpose of removing calculi from the gall bladder. According to the information derived from a paper published by Musser and Keen in the *American Journal of Medical Sciences* for October, 1884, and supplemented by a paper by Bernays, of St. Louis, and published in the *Weekly Medical Review* for October 31, 1885, 42 cases of cholecystotomy have been reported, not including those examples in which the operation has been made for the evacuation of matter, of which number 32 are said to have recovered, and 10 to have died; the examples of recovery including seventeen by Tait, and two by Bernays, neither of these gentlemen having lost a patient by this operation, although neither of them adopted the antiseptic system. Says Bernays, speaking of his own operations, "all possible regard was paid to cleanliness, etc." . . . "Clean water was used, unadulterated by bichloride of mercury, carbolic acid, or any other poison." Further reference will be made to the employment of antiseptics in surgical operations in the supplementary chapter of this treatise, entitled, "The art of primary union of large incised wounds."

It seems necessary to remind the reader again that, in estimating the relative safety of this, or of any other operation in surgery from published records, gathered from various sources, it is always worth while to take into account the fact that a certain number of unsuccessful cases never find their way into the journals. But even with this allowance, the ratio of mortality is sufficiently low to justify the conclusion that this operation must be accepted as one of the legitimate alternatives of surgery.

That great care must be exercised in the diagnosis of affections of the gall bladder before resorting to an operation, and that the diagnosis is sometimes exceedingly difficult, the experience of Bernays may be offered to illustrate. In his first case, the existence of calculi in the gall-bladder was not known or suspected by any of the very intelligent surgeons who examined the tumor until a free incision revealed their presence; and in his second case, the existence of calculi having been made out to the satisfaction of all the surgeons, the operation disclosed the fact that none were present. The frankness with which these facts are stated by Bernays, entitles him to the confidence and respect of medical men.

The operation of cholecystotomy may be thus briefly described: an incision is to be made through the abdominal walls along the linea alba, or, as recommended by Sims, about two and a half inches below and parallel to the free margin of the ribs; the choice of the one or of the other of these methods, and the exact point of the incision, being determined by the location of the tumor, if any be present. The gall bladder being exposed and, if practicable, brought outside of the cavity of the belly, is to be opened longitudinally, and the calculi removed. The wound in the gall bladder is then closed by very fine silk ligatures—interrupted—and the ligatures cut close to the knots. To complete the closure of the vesical wound, and to reduce to a minimum the chances of the subsequent escape of bile, the Lembert sutures should then be introduced, made also of fine silk. This suture, which has received the name of its inventor, is inserted into the peritoneal surface of the gall bladder, a few lines from the margin of the wound, on one side, and brought out at a point equally distant upon the opposite side. The ligatures being tied, and cut close to the knots, they cause an inversion of the margins of the wound, bringing the peritoneal surfaces in contact, between which, as is well-known, adhesion occurs very promptly. The abdominal wound is then closed in the usual manner.

This was the method pursued by Bernays in his two successful cases, and it is that which seems most to commend itself in all cases to the judgment of the practical surgeon.

Cholecystectomy, or excision of the gall bladder, recommended by Langenbeck as a substitute for cholecystotomy, and of which there are six examples reported, with two deaths, can only be appropriate in the case of some malignant disease of this organ, and even then its propriety must be questionable.

Cholecystenterostomy, or the attempt to establish a communication between the gall-bladder and the small intestines, of which only one example is reported, is entitled to no further consideration than its mention, and to say that it proposes to substitute a very unsafe and uncertain operation for one which is comparatively safe and certain in its results.

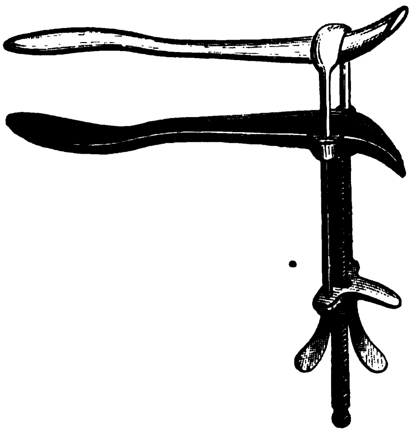
CHAPTER XVI.

SURGERY OF THE RECTUM.

Speculum Ani.

Surgeons have invented a number of instruments for the purpose of inspecting the interior of the anus and rectum; but none of them possess very much value. The rectum expands suddenly above the internal sphincter, and it is impossible, with any speculum, to bring into view the walls of the canal above this point, unless they happen to be thrust downwards in the direction of the anal aperture. Even the instruments recently invented, constructed upon the same principle as the endoscope, with reflectors, have proved to me very unsatisfactory in the explorations of the deeper portions of the rectum. They are exceedingly difficult to manage, and do not, when most carefully applied, bring into view more than a very small portion of the field. It is well known, also, that in the limited space comprised between the external and internal sphincters, specula afford very little assistance, unless the sphincters are already paralyzed, or the patient is completely under the influence of an anæsthetic. The specula which will, perhaps, be found most useful, and applicable to the greatest variety of emergencies, are,

Fig. 378.



Thebaud's Speculum Ani.

the bivalve speculum invented by Dr. J. S. Thebaud, of this city--designed to be used, also, as a dilator or divulsor ani—and the ordinary fenestrated speculum. A pair of lithotomy forceps has, in many cases, served my purpose completely.

But after all, the surgeon will often succeed quite as well by requesting the patient to strain and thrust out the rectum, while he separates the nates, and with his thumbs and fingers everts the mucous membrane of the anus; especially if he can have the opportunity of making the examination immediately after the patient has evacuated the bowels.

Foreign Bodies in the Rectum.

When foreign bodies are lodged in the rectum, and require to be removed, the patient should be placed at once completely under the influence of an anæsthetic, which, by relaxing in some degree the sphincters, facilitates the exploration of the rectum, and the removal of the offending substance. The fingers should be well oiled, and introduced slowly; while an assistant draws the integument aside from either side of the anus. The instruction given to introduce the finger slowly, has a practical application to all cases in which it is necessary to explore the rectum. By this method we imitate nature in the expulsion of fæces, and the sphincter gives way with the application of only a moderate degree of force, and generally without pain, even when anæsthetics are not employed. Having determined the position of the foreign body by the finger, a pair of strong blunt forceps may be introduced, and the extraction effected before the finger is withdrawn. It is possible, indeed, when the patient is an adult and thoroughly anæsthetized, to introduce the whole hand into the rectum, and remove whatever it may contain, as my pupils at Bellevue saw me do during the winter of 1869-70; but this necessarily causes laceration and temporary paralysis of the sphincters, and is not to be recommended, unless in the event of the failure of more gentle means. Pollack, in the *Wiener Med. Presse*, 1869, relates the case of a man who had a champagne bottle thrust into his rectum on a wager, where it remained for twenty-six days. It was finally extracted by the aid of a steel hook, and the patient soon regained his ordinary health.

Congenital Occlusion of the Rectum and Anus.

Congenital occlusion of the anus and rectum presents itself in various forms. First, the anus may be closed by a thin tegumentary covering; second, the intestinal tube may terminate a little above the internal sphincter, within an inch—more or less—of the integument; third, it may terminate at any point intermediate to the sigmoid flexure and the internal sphincters, and in either of the last two cases it usually forms at its termination an expanded pouch or cul-de-sac; fourth, there may be a narrow canal, large enough, perhaps, to admit a goose-quill extending upwards from the anus from one to three inches, while the intestinal canal terminates in a similar blind pouch a short distance above, leaving an intermediate and generally pretty firm fibro-cellular diaphragm; fifth, the anus and lower portion of the rectum may be absent, and the gut may end in a small fistulous orifice upon the inner wall of the bladder, urethra, vagina, or by a side canal it may open, like a fistula in ano, anywhere in the perineum; or it may terminate upon the anterior or lateral walls of the belly.

Treatment.—The management of the first and most common form of atresia ani is exceedingly simple. The tegumentary septum is to be cut freely, either by a longitudinal or crucial incision. The subsequent discharge of fæces will maintain the orifice in a patulous condition.

In the second variety, the surgeon will, in most cases, acquire a sufficient knowledge of the extent of the occlusion as early as the second or third day, by the amount of bulging when the child strains to evacuate the meconium. If this is considerable, and especially if a certain degree of fluctuation can be felt, the rectal cul-de-sac is not very far off, and with a trocar and canula, or with the knife, the surgeon may hope to reach the intestinal canal safely. When the knife is employed, in the case of a male child, a straight steel sound, or a strong silver probe should be introduced into the bladder, and retained during the operation, in order to avoid wounding the bladder or urethra. The incisions must be made cautiously, following the direction of the curve of the sacrum, and feeling occasionally, with the finger in the wound, for the bulging of the rectal cul-de-sac. Access having been gained to the gut by an orifice however small, it will be most prudent to enlarge the wound to the required dimensions by a pair of bullet or dressing forceps, introduced closed, and then forcibly expanded. In one of the several operations of this kind that I have had occasion to make, the bleeding was troublesome and alarming, considering the age and feebleness of the patient; the wound was narrow and deep, and it was found impossible to secure the bleeding vessels. The only alternative, in such a case, is to complete the operation; when, having brought down the rectal cul-de-sac, and made it fast to the integument, pressure may be employed with the finger, or with a large bougie. It is always desirable to bring down the rectum, as originally advised and practised by Amussat; but in many cases, especially when the depth of the wound is more than one inch and a half, this will be found very difficult of accomplishment. In order to keep the channel open, it will be necessary to introduce a laminaria tent every day, guarded by a string to prevent its escape within the rectum. It is not necessary to retain the tent in the rectum constantly; a few hours of each day will suffice.

Patients belonging to this class generally survive the operation, but it is not often, I imagine, that the functions of the anus and rectum are completely restored. I can recall two patients who survived a year, and perhaps longer, but they never had a movement of the bowels without the aid of physic; and in the case of one boy, who survived six years, and was then in excellent health, a tablespoonful or more of Epsom salts was always required to move his bowels. The anus in this case had apparently no sphincter muscles, but a couple of small polypi, lying just within the external orifice, seemed to serve the purpose effectually of preventing the involuntary escape of the fæces when the contents of the bowels were liquid.

In the third variety, where, after suitable delay, no bulging or fluctuation indicates the approach of the rectum to the surface, it may still be proper to make the perineal incision; but only with the understanding that the gut is not likely to be reached in this direction, and that in case of failure, colotomy is the only resort.

The fourth variety is, in certain cases, quite as easy of management as the first. A trocar and canula may be made to perforate the membranous or fibro-areolar diaphragm, and the orifice may subsequently be enlarged by the forceps, as already directed in the management of the second variety.

No rules can be given for the treatment of the last variety, or, more correctly speaking, for the several varieties comprised under the fifth division. It will be observed, however, that when the fistulous orifice appears in the perineum, it is thereby rendered quite probable that the intestinal cul-de-sac is in the lower part of the sacral curve; but when it opens upon the walls of the belly above the pelvic basin, and especially if this condition is associated with small, compressed, and receding nates, there is almost certainly a total absence of the intestinal canal below the sigmoid flexure, and perhaps to a much greater extent. In all cases in which there is a small fistulous communication with the bladder, urethra, or vagina, the restoration of the natural channel or the formation of an artificial anus may be expected to result in their ultimate closure; in the case of the lad, however, to whom reference has been made as surviving six years, a fistulous communication with the bladder did not close until the fifth year of his life; but usually it closes much sooner.

Stricture or Narrowing of the Rectum and Anus.

Instead of complete occlusion, the anus and rectum are sometimes found at birth very much narrowed, requiring either incision, or the use of bougies, in order to secure the requisite capacity. At a later period of life the anus may be preternaturally closed by a spasmodic contraction of the sphincter muscles; a condition generally induced by an anal ulcer, by hæmorrhoids, or by some other painful malady in this region; or the stricture may be of a permanent character. There is no portion of the alimentary canal which is not subject to this condition, but the liability is greater at certain points than others. With the exception of the pyloric orifice of the stomach, at which point scirrhus is very common, it may be said that the liability to stricture increases as we descend; but it is especially apt to occur at, or near, the junction of the sigmoid flexure with the colon, and about two inches above the anus. There are many causes which may induce permanent stricture; upon which a classification of varieties might be based. I shall mention only those examples which are most frequent.

Syphilitic and Chancroidal Strictures.—The most common cause of rectal stricture is syphilis and chancroid—especially the latter. At Charity Hospital these cases are constantly under observation, and they are observed to be particularly frequent among the women. The stricture is usually from one to three inches within the verge of the anus; occasionally it is felt as a sharply defined band, in which case it is most often due to the cicatrization of a chancroidal ulcer; but in some cases the stricture has a nodular feel, and is accompanied with other evidences that the patient is laboring under a syphilitic diathesis. In both varieties I have uniformly found the health of the patients greatly impaired.

Treatment.—The therapeutical treatment of syphilitic and of chancroidal stricture will be suggested by the general appearance of the patient. I have seen fit, usually, to recommend for these patients tonics and good diet, with air and exercise. In syphilitic cases the bowels are apt to be loose; but if they are in the opposite condition, oatmeal should constitute a principal article of diet.

When the strictures are sharp and defined, and the health of the patient will warrant a surgical operation, the stricture may be cut posteriorly, and then maintained in a patulous condition with bougies; but I desire especially to warn the surgeon against either cutting or attempting to dilate by force any stricture which has a nodulated feel, and which is evidently dependent upon a syphilitic constitution. In no less than three cases have I seen such practice result in speedy death. Even when the bougie is introduced with considerable care, and daily, it is very apt to cause pain, irritation, and sometimes ulceration of the mucous membrane. Wax, tallow, and India-rubber are generally employed as rectal bougies; but metallic bougies are to be preferred when the aperture is very small, and the canal not tortuous. Some of these patients have derived great comfort, if not permanent benefit, from daily injections of a weak solution of carbolic acid and water; the injection being carried above the stricture by a flexible tube.

Strictures, neither Syphilitic, Chancroidal, nor Cancerous, occurring two or three inches above the anus, are observed now and then, in both private and public practice, and with rather more frequency in the former. These patients are in most cases anæmic, nervous, or hysterical women. The stricture is sharp and often very complete, so that it is with difficulty that the point of the index finger can be introduced; it is, moreover, exquisitely sensitive to the touch.

Treatment.—Attention to the condition of the bowels, improvement of the general health, and the daily and careful use of bougies will in most cases afford great relief; but neither in this nor in any other form of permanent stricture of the rectum can the patient expect a radical and complete cure.

Tumors of the Rectum.

Cancer.—This disease belongs almost exclusively to advanced life When it originates near the verge of the anus, it sometimes appears at first as a simple fissure, whose margins become more and more indurated and elevated, while the ulceration is extending especially upwards in the direction of the mucous membrane. When cancer of the rectum appears in this form it is generally epithelioma, and I believe I have saved a few lives by removing these indurated ulcers freely with the knife, and treating the cases as we are accustomed to treat epithelioma of the lip, closing the wound and securing prompt union of the opposing surfaces.

Epithelioma and scirrhus occurring above the sphincters are not, in my judgment, curable by any surgical operation. Cures have been reported after the removal of large portions of the rectum for both epithelioma and scirrhus, but not upon reliable authority.

Fibro-recurrent Tumors, having a broad base, and smooth, round surface, according to Erichsen, sometimes occur just within the sphincters. They may be removed by the whip-cord ligature; but no assurance can be given that they will not return.

Mucous and Fibro-mucous Polypi are not very unfrequent in the neighborhood of the sphincters, especially among children. Either of these forms of intra-rectal growths may be removed with great ease and safety by the ligature. **Warty** and **villous tumors** are also occasionally met with in this region, the latter of which has been particularly described by Mr. Quain.

Venereal Warts and **Syphilitic Tubercles** are to be treated upon the same general principles which govern their treatment elsewhere. (See Syphilis.) If, however, it is proposed to remove vascular venereal excrescences or other similar growths from this region, by the knife, the surgeon will bear in mind the greater danger of hæmorrhage here than in most other portions of the body subject to these formations.

Anal Fissure. Syn., Rhagades Ani, R. C.; Fissura in Ano.

The term "anal fissure" has been applied to what is in fact only a simple ulcer of the mucous membrane; but which, in consequence of its peculiar situation, ordinarily assumes the form of a fissure, and is, moreover, a source of great suffering, and exceedingly difficult to heal. It is situated in most cases just within the verge of the anus, and generally in the direction of the coccyx, extending upwards in a fold of the mucous membrane often as high as the internal sphincter, and sometimes considerably beyond this point. An anal fissure is in a few cases the result of a laceration, caused by the passage of hardened fæces but in a large majority of examples its existence is due to those condiions of the general system which provoke ulcerations in other mucous membranes, such as a venereal, scorbutic, or tuberculous diathesis, disorders of the stomach and bowels, general anæmia, etc. It is prone o occur in connection with hæmorrhoids.

The existence of a fissure may always be suspected when the patient observes that although he experiences very little or no pain in the act of defecation, it is certain to commence soon after, and to become in he course of a few minutes excessive. By the contraction of the phincter upon the remains of the fæcal matter, the sore is chafed and loaded, inducing the muscular fibres to contract with still greater violence, and thus the suffering is by reciprocal action constantly increased, lasting sometimes several hours, or until the muscular irritability is exhausted and the sphincter again becomes relaxed.

Treatment.—When the ulcerations are limited in extent, or do not depend in a great degree upon general causes, a cure may often be efected by careful attention to the condition of the bowels, and by washng the protruding rectum with warm water and soap after each evacuaion. Benefit is often derived, also, from the application of a mildly timulating unguent by means of a camel's-hair pencil, immediately fter washing the ulcer; and then resting half an hour or an hour in the ecumbent posture. Solutions of alum and of sulphate of zinc are ometimes efficacious, or the occasional application of the nitrate of silver in substance; but in case these and other therapeutical means fail, we have a very certain remedy in those measures which for a time ompletely paralyze the sphincters.

Incision of the external sphincter, first recommended by Boyer, has ince his day been generally practised; the knife being introduced t the seat of the fissure and made to cut outwards until the circular nd elliptical fibres are completely divided. The wound is then dressed with lint, and the cure is in most cases accomplished when the wound has completely healed. Mr. Brodie thought it unnecessary to cut the whole of the sphincter, but recommended incision of the mucous membrane alone, including perhaps a few of the submucous muscular fibres; he entire depth of the wound being not usually more than one line. Erichsen is satisfied with this method also. Gross recommends a simiar practice, or merely excision of the indurated margins of the ulcers. cannot, however, agree with either of these distinguished surgeons as o the general efficacy of simple incisions. They seldom or never succeed, according to my experience, except in that class of cases which are generally amenable to therapeutical measures alone. The method perhaps always merits a trial, since it is attended with very little pain and with no hazard, but it will be prudent not to promise success. If Boyer's operation is practised, the incisions should never be made diectly backwards opposite the point of the coccyx, since in this direcion the elliptical fibres will be split and not cut asunder; nor directly forwards in the female, by which operation fæcal incontinence has been sometimes occasioned. In cutting horizontally outwards, also, care must be taken to keep the anus stretched between the thumb and finger, or with a bivalve speculum, so that the surgeon may recognize the division of the muscle by the sensation, and thus avoid the danger of cutting too deeply, and perhaps of wounding some of the perineal arteries.

Recently it has been suggested by Récamier to paralyze the sphincter by forcible stretching of its fibres. I have practised forcible dilatation in a good many cases, and while I cannot speak positively of the results in all, since some of them passed from under my observation before the usual period of treatment had elapsed, yet I am able to say that of those which remained under observation all have been cured. The method of operating is as follows:—The patient being placed under the influence of an anæsthetic, the surgeon introduces both thumbs into the rectum and draws forcibly outwards until he touches the tuberosities of the ischia. In some cases when the anus is unusually dilatable, the thumb may be allowed to slide off from the tuberosities so as to continue the stretching beyond these limits. In doing so, however, care must be taken, especially in persons of lax and feeble texture, not to carry the dilatation too far. I have once caused a thrombus in making too forcible extension; and it is possible to tear the rectum completely open. Some bleeding always follows the operation, but it is usually slight and soon ceases spontaneously. The after-treatment consists in frequent ablutions with tepid soap and water, and rest in the recumbent posture. No physic should be given earlier than the third or fourth day, nor will it then be required unless the bowels are constipated.

Anal Fistula. Syn., Fistula in Ano, R. C.

A "complete" fistula in ano consists of a fistulous canal leading from the rectum to the outer surface of the integument. Of "incomplete" anal fistulæ, called also "blind fistulæ," there are two forms, namely, the external and the internal. Complete anal fistulæ occur most often in tuberculous or syphilitic patients, or in persons whose health is in some way already seriously impaired. They are frequently results of chronic dysentery, low fevers, and of hæmorrhoids; but in a large proportion of cases they have their immediate source in perforating ulcers of the mucous membrane, situated just above the external sphincter, which, having penetrated to the subjacent areolar tissue, and having received a portion of fæcal matter, form ischio-rectal abscesses. In due time these abscesses open somewhere in the neighborhood of the anus, but not in general until the matter, arrested in its progress toward the surface by the superficial perineal fascia, has formed sinuses leading upwards along the outer wall of the gut, or laterally in the direction of its circumference.

Treatment.—Complete fistulæ are very seldom, if ever, cured, except by a surgical operation; indeed, we do not see how such a result can be expected so long as the contents of the intestine are permitted to pass freely into the ischio-rectal cavity, while, as is uniformly the case, they are not permitted to escape with equal freedom from the perineal opening. A study of the anatomy of the structures involved would lead us to infer, also, what clinical experience has established, that there is but one surgical expedient which has any proper claims to consideration, namely, division of the external sphincter.

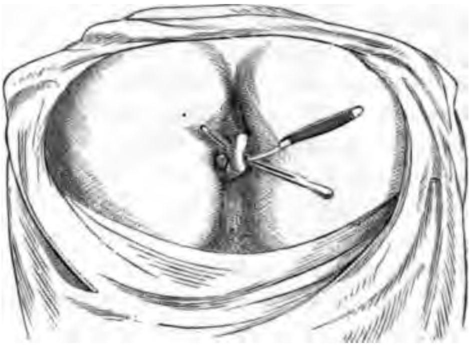
The external, or lower sphincter, is composed of two sets of muscular fibres—the elliptical and the circular. The circular fibres are merely a continuation of the involuntary circular muscular fibres of the rectum. They lie in immediate contact with the mucous membrane at the anal orifice, and, by the aid which they give to the elliptical fibres, insure its complete closure. The elliptical or voluntary fibres of the sphincter are not continuous, but compose two flat muscular planes, whose anterior extremities are attached at the "common point of junction" in front of the anus, while their posterior extremities are attached to the coccyx; they are intimately adherent to the integument surrounding the margin of the anus, and at this point they measure about half an inch in breadth. The internal or upper sphincter, situated in the adult about one inch higher, is composed entirely of circular, involuntary fibres, and is incapable of closing the canal completely; in fact, it serves only as a break-water, to receive the first strain of the downward pressure, and to mould into a somewhat conical form the fæcal mass.

These constitute the anatomical reasons why an ulcer, or any lesion of the mucous membrane situated just within the external sphincter, cannot repair itself, so long as the sphincter retains its normal contractile power. At this point alone is the descent of the intestinal contents completely arrested, and forced to seek an outlet against its walls; and whenever the smallest amount of fæcal matter has penetrated the mucous membrane, it is urged forward incessantly, until it causes suppuration, and finds an aperture of escape through the skin. For the same reason, a fistula once formed, and communicating with the rectum, cannot be made to heal until the sphincter is paralyzed; but, as when the dam is removed, the sluice-way will dry up, so when the external sphincter is cut, the fistula will heal.

In a large proportion of all the examples of complete fistula which have come under my notice, the rectal aperture has been within half an inch of the verge of the anus; and when, owing to the tortuous course of the canal, the probe has not been able to find the internal opening, it has been soon recognized by the finger introduced within the anus; or, it has been seen by carefully everting the mucous membrane. The probe, or a somewhat flexible grooved director, being now thrust into the rectum, and brought out at the anus, the operation is completed by dividing the intermediate tissues.

There will be found a few examples, no doubt, in which the internal orifice is above the internal sphincter; but even in these cases it will be prudent to first try the effect of cutting the external sphincter alone. In most cases this operation will be successful; and if the surgeon has cut many fistulæ by the high incision, he will be reluctant to take the chances of a troublesome bleeding, to which his experience must have taught him the patient will be thereby exposed; or, indeed, if he will before operating introduce his finger, and feel carefully for the pulsation of the hæmorrhoidal arteries, he will usually find sufficient reason for preferring the low incision.

Fig. 379.



Operation for Fistula in Ano.

Having cut the sphincter, it only remains to lay a small piece of lint between the margins of the wound, and place the patient in bed. As in all other operations about the rectum, it will be assumed that the surgeon has taken the precaution to empty the bowels, and especially the rectum, the day previous to the operation; and that he will now insure quiet for the following two or three days by a small dose of opium.

In certain cases fistulous openings exist upon both sides; and although division of the sphincter upon one side is sometimes adequate to the cure of these cases, it will do no harm, and will render the cure more certain, to cut the sphincter on both sides at the same time. Where the integument is extensively undermined the cure will be hastened by free incisions in whatever direction the underlying cavities may extend.

As to the treatment of anal fistulæ by the ligature, I do not think it is for a moment to be considered unless the surgeon has become convinced that the gut must be divided above the internal sphincter. In such a case, a seton may be passed, and tied moderately tight over the included tissues, in order that he may in this manner obliterate the vessels, and thus prepare the way for the completion of the operation safely by the knife. Complete division of the tissues by the ligature is tedious, painful, and attended with more danger to life than the judicious employment of the knife.

Incomplete Internal Fistula.—When the fistula is *incomplete,* and *internal,* it will be proper first to render it complete, by an external incision and then adopt the treatment already recommended for a complete fistula.

Incomplete External Fistulæ, the effect often of blows upon the ischio-rectal region resulting in the formation of abscesses—sometimes depending upon caries or necrosis of the ischiatic bones, but still more frequently following upon a simple furunculus—generally get well without any other surgical interference than giving a free exit to the matter, or exposing and removing the necrosed bone. They at least do not, as a rule, demand the division of the sphincter. Nevertheless, this operation becomes necessary in some cases, on account of the inability of the fistulous channel to become closed, so long as its inner wall is subject to the influence of the sphincter, since at each contraction of the muscle the walls of the channel tend somewhat to separate from each other.

Some physicians and surgeons have thought it unadvisable to close a fistula in ano when the patient was laboring under phthisis. My experience does not permit me to entertain this opinion. The purulent discharges in these cases are often excessive and exhausting, and the continuance of the fistula provokes intestinal irritations, causing tenesmus and diarrhœa; and it has happened to me in several instances to witness a marked improvement of the general condition of tuberculous patients when a cure of the fistula had been effected. Nor is there, we think, any better ground for the opinion which some have entertained, that if the fistula is cured at all in these cases, it should be accomplished gradually, by the ligature for example. The truth is, however, that fistulæ occurring in consumptive patients are pretty sure to heal slowly, even when the knife is employed; and in fact the great danger is, that with our best-directed efforts they will never be made to heal; but if there is any probability that the fistula has served a useful purpose as a derivative, it is much better to place an issue in the arm or in some other part of the body, rather than permit the continuance of the fistula.

Hæmorrhoids. Syn., Hæmorrhoides, R. C.; Piles.

The term "hæmorrhoids" is applied to certain tumors formed in the lower part of the rectum and about the anus, by dilatation of the hæmorrhoidal veins, and more especially of those which compose the submucous hæmorrhoidal plexus; which condition of dilatation is usually accompanied with hypertrophy of the walls of the veins; and, when they have been subjected to frequent attacks of inflammation, by hypertrophy or infiltration of the adjacent areolar and mucous tissues. The terms usually employed to designate the varieties of piles—

depending upon their seat and hæmorrhagic or non-hæmorrhagic character—are "external" and "internal," "bleeding" and "blind."

Hæmorrhoidal dilatations sometimes occur suddenly, but they are, in most cases, of slow and irregular growth, appearing and receding from time to time, but increasing steadily in size upon each successive return. They may be caused by whatever gives rise to congestion of the hæmorrhoidal veins; and they have been most often induced by violent straining at stool to expel hardened fæces, or to obtain relief in the tenesmus resulting from diarrhœa and dysentery. Sedentary occupations favor their occurrence; visceral obstructions, and especially such as prevent the free return of the blood through the portal system, constitute active, indirect, or predisposing causes; they are said also to have been often caused by riding on horseback; but our own experience does not confirm this latter observation. If certain classes, such as cavalry officers, who use the saddle a good deal, have been shown to be peculiarly liable to piles, it must, we think, be attributed to some other cause; since the disease is rare in those portions of our own country where the horse furnishes the principal mode of conveyance and of travel. It may be well to suggest to those who find themselves troubled with piles, and who may be disposed to attribute their misfortune to the saddle, that one of the most fruitful causes is that constant excitement of the mucous membranes which so generally ensues upon the free and habitual use of wines, whiskey, and other stimulants. Horseback riding is, in our estimation, a hygienic measure of inestimable value in a great variety of human maladies, and we would regret that it should be made responsible for the consequences which belong legitimately to other less useful practices.

Therapeutical Treatment.—The general treatment of hæmorrhoids consists, *first*,—in the removal of all those causes which predispose to, or excite venous congestion in the rectum. Active out-door occupations must be substituted for those which are sedentary. Habitual constipation must be overcome by laxative diet, and by absolute regularity in the evacuation of the bowels;—neither cathartics nor enemata will ever accomplish this most important indication. In case, however, the bowels are loaded with fæcal accumulations, a single active cathartic may prove serviceable; and especially will this practice be found useful, when with this condition of the bowels there are associated constantly recurring hæmorrhages. Tenesmus and diarrhœa must be restrained by appropriate remedies. The patient must not permit himself to sit long upon the stool; and, immediately that the evacuation has occurred, he must bathe the anus and the protruding piles with cold water. After gently wiping the parts, they should be lubricated with simple cerate, cold cream, glycerine, flaxseed or slippery-elm water; and, if protruding, they must be pressed back, if possible, while the patient is in the supine position with the hips elevated, or supported upon his knees with his head and chest resting upon the bed. If the hæmorrhoids are inflamed and swollen, and cannot be made to retire, continued rest, with cold applications, or with poultices, may be required. *Second,*—in the employment of those agents which experience has shown to possess a somewhat specific influence over congestion, irritation, and inflammation of mucous membranes. Among these the terebinthinate and balsamic remedies occupy the first rank; and Bishop Berkeley's famous "tar-water" has not lost its reputation as a domestic remedy in our day. In doses of about one drachm of tar daily, in half a pint of water, it is a gentle laxative, and a very effective sedative to an irritated rectum; or the tar may be given in the form of pills, five to ten grains daily. Fifteen or twenty drops of the balsam of copaiba, or ten of the spirits of turpentine, properly diluted, and taken every night for a few days or weeks, we have found exceedingly serviceable, especially in cases of bleeding piles. Sulphur, with magnesia and Epsom salts, prepared according to the following formula, is particularly recommended by my colleagues, Drs. Van Buren and Elliot:—℞. Magnesiæ; magnesiæ sulphatis; sulphuris precipitatis; sacchari lactis; āā ℥ ss.; pulv. anisi, ʒ ij. M. Of which one or two teaspoonfuls are to be taken in water at bedtime.

By careful attention to the foregoing rules a "paroxysm" of piles may be often relieved, and their recurrence rendered less frequent. Indeed it is possible, by strict attention to hygiene, to accomplish a radical cure in certain exceptional cases. When the piles are external, the cure may sometimes be facilitated by the application of the nut-gall ointment prepared as follows:—℞. Pulveris gallæ, ʒ i.; liquor. plumb. diacet. gtt. xv.; adipis, ℥ ss. M. It must be understood, moreover, that external piles are frequently cured spontaneously, by a rupture and extravasation of their contents, by suppuration, or by consolidation and subsequent absorption of the products of inflammation. The flabby, pediculated, tegumentary masses often seen around the verge of the anus in persons who have long suffered from hæmorrhoids, are generally the vestiges of old and spontaneously cured external piles.

Surgical Treatment of External Piles.—Small tegumentary folds, which are usually the remnants of old piles, sometimes become chafed or inflamed, causing sufficient annoyance to require their removal. They may be cut away, when not inflamed, with a pair of scissors, in the direction of the folds of the anus. If any considerable portion of integument is removed in the direction of the circumference it may cause contraction of the anal aperture. The surgeon must bear in mind, also, the possibility of the excision being followed by a troublesome bleeding; and as it is impossible generally to tie the bleeding vessels, he must be prepared with the dry persulphate of iron, lint, and compresses, to control it if necessary.

A suddenly formed, round, very tense and purple tumor occurring in this region, is the result of the rupture, and not of the dilatation of an external hæmorrhoidal vessel; and, if not complicated with inflammation, it may be opened and its contents allowed to escape, when a spontaneous cure will usually be effected. Sometimes, however, when the coagulated blood has been pressed out from a thrombus of this kind, it continues to bleed, and the bleeding may require for its arrest the persulphate of iron or the ligature applied to the entire mass. When a hæmorrhoidal thrombus is inflamed it is even more likely to bleed freely after incision; but the application of persulphate of iron, of pressure, or of the ligature in mass, to acutely sensitive and inflamed tissues, are alternatives to be avoided if possible. We had better, therefore, leave these inflamed thrombi to subside slowly under absorption, or perhaps to suppurate—the latter of which is the least frequent result—rather than to resort at once to free incision. If, however, in any case, the great suffering which they occasion seems to demand immediate relief, we may make two or three small punctures, with tolerable safety and with some advantage to the patient.

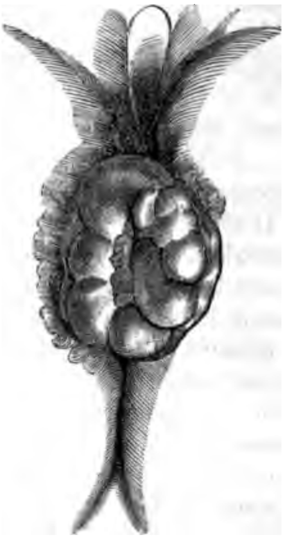
If the verge of the anus presents one or more purplish, shining tumors which have formed more slowly, they are probably examples of simply dilated veins, or, as is more frequently the case, the tumors are composed of congested veins and arterioles with more or less of the products of inflammation, which have assumed a mottled purple and reddish color in consequence of a partial strangulation caused by the sphincter. These tumors cannot be made to retire within the anus, inasmuch as they have their attachments, at least in part, externally; and they must be soothed by cold applications and poultices, being permitted to remain where they are; and not until the inflammation has entirely subsided will it be prudent to attempt their extirpation.

Many surgeons who do not advocate the use of the knife in internal piles, do not hesitate to recommend and practise this mode of operating in external piles; but it will be observed that in a large majority of cases the base of the pile extends fairly within the sphincter; and excision under these circumstances is attended with no inconsiderable danger of internal bleeding, in consequence of the retraction of the wound within the anus. It is more prudent, I believe, and this with few exceptions has been my practice, to ligate external hæmorrhoids in the same manner that I shall presently advise the ligation of internal hæmorrhoids. Simple incision will often prove sufficient for their cure; but if this method is adopted the surgeon must not be surprised to find it necessary to apply the ligature subsequently, to arrest the bleeding.

This is the only class of cases in which it would ever seem advisable to attempt the treatment by nitric acid; but as it is no more radical than the ligature, and much more tedious, it is difficult to see why it should be preferred.

Surgical Treatment of Internal Piles.—External piles occasionally rupture from unusual efforts at stool and bleed freely, but such an occurrence is quite exceptional; while internal piles are exceedingly prone to hæmorrhages, indeed it is quite as exceptional when they do not bleed, so that the subject of this latter affection becomes in the course of a few years blanched by the constant drainage, and the general health is in most cases seriously impaired. The reason for this marked difference is to be found in the greater delicacy and vascularity of the mucous membrane within the sphincters an inch or two above the anal aperture. Not only the veins, but the mucous membrane itself becomes hypertrophied at the point where internal piles occur; it becomes much more vascular and covered with granulations which present a velvety appearance, like the granular conjunctiva, and from which blood can be made to ooze like sweat whenever they are pressed. These vascular granulations, and not the dilated veins, are the usual sources of the hæmorrhages. It is mostly arterial blood which escapes in this manner; and sometimes an arteriole may be seen to be actually ruptured, and the blood will escape from the surface in a fine sharp jet.

Fig. 380.



Internal Piles.

When these tumefied and vascular portions of mucous membrane, enclosing hypertrophied veins, are thrust down from time to time, until at length they emerge from the anus, they drag with them considerable portions of the gut, and bear some imperfect rememblance to what is properly designated as "protrusion of the rectum;" only that there is at first but one tumor protruded, then a second, and finally a large number, giving to the surface of the gut, as it lies exposed after a stool, a bossed appearance, such as does not belong to simple protrusion of the rectum.

When these are permitted to remain down too long they often become strangulated by the sphincter, and swell enormously. In some cases they have sloughed off, and a spontaneous cure has been effected, but always at the hazard of forming a stricture when the cicatrization is completed.

To reduce them under these circumstances is not always an easy matter; but this can generally be accomplished if, while the patient is resting upon his back, with the hips elevated, the surgeon, having covered the mass with a piece of lint smeared with cerate, grasps the tumors with his fingers, so as to press with their extremities upon the margin of the sphincter, and then bears up steadily for a few moments. The sphincter will often, under this pressure, be coaxed to dilate, and the tumors may then pass in easily.

When, from frequent extrusion, the sphincter has become relaxed, they are liable to fall down at any hour of the day, and at most inconvenient seasons. A pad, or a compress, supported by a bandage, sometimes affords relief in these cases; and when they do not the patient must be advised to have his regular daily stool at bedtime, and not in the morning. After an evacuation the sphincter remains relaxed and open, sometimes two or three hours; but during the night it recovers its contractile power, and, if not put upon the stretch in the morning again, the patient may escape these annoyances during the day.

An operation for the radical cure of internal piles will in most cases sooner or later become necessary, and delay can seldom be properly advised. Surgeons are not without expedients in this class of cases: but we shall dismiss most of the methods devised, and sometimes practised, with very few words:—

Excision.—Since Dupuytren has told us how he used to thrust a red-hot iron up the rectum to arrest a bleeding caused by cutting off internal piles, very few have ventured to imitate his example. No one to-day practises excision of internal piles.

Actual Cautery.—The treatment of this malady by the heated iron is equally unsafe with excision, and may be regarded as an expedient deserving to be mentioned only as cruel and barbarous.

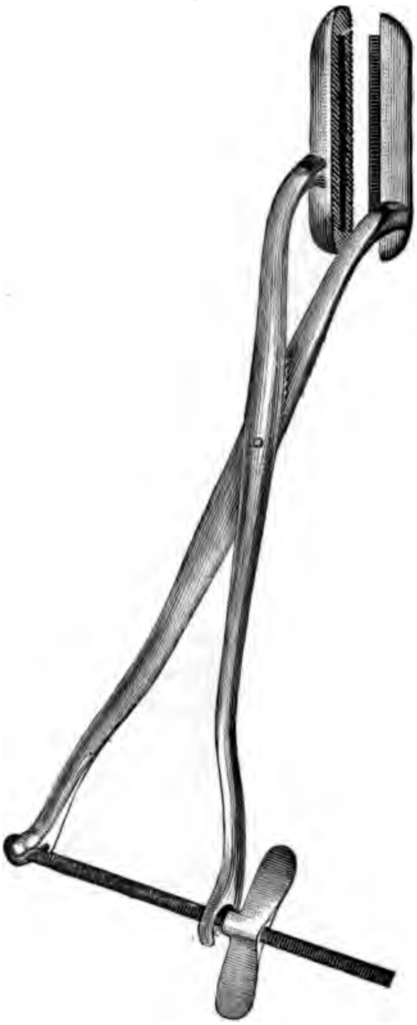
Potential Cautery.—Various mineral and vegetable escharotics have occasionally been employed, but most commonly undilute nitric acid. If the hæmorrhoids can be well thrust out, and do not quickly recede, nitric acid may be used with a tolerable degree of safety; but the remedy is often slow and tedious in accomplishing the cure, and never so certain as the ligature. It has been considered as particularly applicable to those cases in which the mucous membrane covering the hæmorrhoids is granular or villous in appearance. The method of using nitric acid preferred by myself, is to touch a portion of the centre of the tumor with a piece of soft wood, sharpened, and holding a single drop of the acid, and then drying the surface thoroughly with lint, or covering it with lint saturated with an alkaline solution.

Galvanic Cautery.—The use of the galvanic current as a means of cauterization appears to me a complex and cumbrous method of accomplishing what can be done equally well by a much more simple process. If either were to be employed, I would prefer the heated iron or nitric acid.

The Ecraseur.—It has been often affirmed that by means of the ordinary chain-écraseur we may operate successfully, and without fear of hæmorrhage. In reply, I wish to state that I have had with this method a limited but very satisfactory experience. I removed a single internal hæmorrhoid from a gentleman in the fall of 1869, by the écraseur, taking great care to proceed slowly, as is advised by those who employ the instrument for this purpose; but the bleeding which immediately followed was terrific, and my patient was only saved by hastily drawing out the rectum with a vulsellum, and applying, by the aid of needle, a strong ligature to the wounded tissues. A friend of mi has recently had a similar experience; and probably neither of us will ever feel justified in resorting to this method again.

Dr. J. C. Nott, of New York, has had constructed what he terms a "rectilinear écraseur;" by the employment of which, in cases of internal hæmorrhoids, he believes that we may avoid in a great measure the danger from hæmorrhage incident to the use of the ordinary écraseur; he also thinks it less liable to cause rectal strictures, inasmuch as it does not, when properly applied, embrace so large an amount of structure. The instrument is composed of two parallel blades, which close like a clamp. One blade has a narrow fenestra running nearly its whole length; and the other is constructed with a tenon, serrated like the teeth of a fine saw, which, when the instrument is closed, occupies completely the fenestra or mortise in the opposite blade. There is, also, a shoulder projecting on each side of the blades for the purpose of crushing more perfectly the tissues. This instrument does not, like the écraseur of Chassaignac, completely sever the parts to which it is applied, but only crushes them, leaving a small pedicle, to which Dr. Nott advises, as a matter of prudence, in the case of internal piles, the application of a ligature. The vitality of the tissues being destroyed by the écraseur, the ligature causes no pain. Some years since Dr. Isaac E. Taylor, of Bellevue Hospital, devised a very similar instrument for the removal of intra-uterine growths. There can be no doubt that either of these instruments, and especially that of Dr. Nott, which is lighter and better suited to the treatment of the malady in question, ought to be preferred to the écraseur of Chassaignac.

Fig. 381.



Nott's Rectilinear Ecraseur.

Ligature.—The ligature alone has endured the test of time and experience. Employed from an early day by the most judicious surgeons, it continues to furnish testimony of its safety, simplicity, and efficacy. Up to this moment, although I have used the ligature in some form a great many times, no troublesome bleeding has ever followed, and, with one exception, no accidents of any kind have ever given me cause for anxiety or alarm.

The exception to which reference is made was in the person of a man at Bellevue Hospital, in which case a chill occurred on the second or third day after the operation, followed by delirium and some coma. His skin became icterode, and the bowels tympanitic. The precise character of the secondary lesion was never determined, although pyæmia was suspected, but he made a complete recovery after a few weeks' illness. It was subsequently ascertained that the man was very intemperate, and that he came into the hospital just after a debauch. To these circumstances, less than to the operation, it seemed proper to attribute the alarming sequences of the operation. Moreover, so far as my knowledge of my own cases extends, the operation has almost invariably resulted in a complete cure. Drs. Van Buren and Valentine Mott have recorded a similar and equally fortunate experience with the ligature. What more can be said of any other mode of operating?

If the patient is to use an anæsthetic, the bowels should be emptied by a cathartic on the day preceding the operation; and if the operation is to be made at 10 A.M., he should take half a grain of opium, and the rectum should be washed out with water alone at 8 A.M. In most cases, the patient being placed in position, the pile may be seized and drawn down with a vulsellum. In case this is found to be difficult or impossible, we may follow the suggestion made by Dr. Van Buren, and the value of which I am able to confirm, namely, to first paralyze the sphincter by stretching it, as in the operation for fissura in ano already described. There will be no difficulty then in reaching and withdrawing the hæmorrhoids. A large needle, armed with a stout double ligature, is now to be thrust through the base of each hæmorrhoidal tumor, separately, and the needle being removed, the ligatures are tied firmly on each side, and cut away close to the knots. It is not necessary to draw upon the ligatures with immoderate force, such as would endanger the complete or partial section of the tumor. If there are many tumors, it will not be prudent to tie them all; nor is it necessary. When one or two are strangulated upon each side of the anus, the remainder usually disappear in consequence of the inflammation which results. After the application of the ligature the piles may be reduced, or if this is impracticable, or causes much pain, they should be permitted to remain and be treated with poultices. The bowels should not be disturbed until the third or fourth day; when a dose of castor-oil, followed by an enema of tepid water, will generally be required.

When the operation is made without an anæsthetic, the patient should sit in a basin of warm water a few minutes until the sphincter is relaxed and the hæmorrhoids sufficiently protruded; or he may restrain the evacuation of his bowels until the operation is about to be made; immediately after which it will be found that the parts are in the most favorable position for observation.

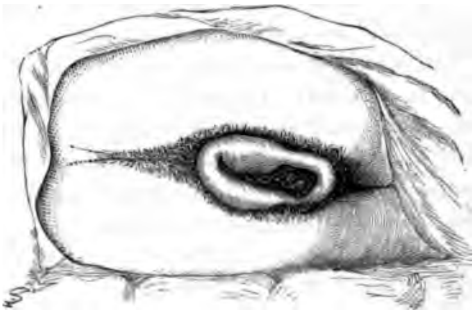
Prolapsus of the Rectum. Syn., Prolapsio Recti Intestini, R. C.; Prolapsus Ani.

Prolapsus of the rectum presents itself under two forms. The prolapse may occur as a true intussusception, the lower, middle, or upper portion of this canal being invaginated, and thrust out from the anal aperture. There is reason, also, to suppose that this invagination sometimes exists without appearing at the anus, causing a more or less complete obstruction to the passage of the fæces, and perhaps eventually a stricture. (See Intussusception.)

The second form of prolapsus commences as a tumefaction of the mucous and sub-mucous tissues, near the verge of the anus, or just within the sphincters; in consequence of which these structures, which are only loosely attached to the muscular walls of the rectum, become extruded from the anus and roll out, forming a more or less perfect circle of swollen mucous membrane. The causes continuing to operate for a length of time, the tumefaction extends upwards, involving more and more of the walls of the gut; and at length the muscular coats themselves are drawn down and protruded, constituting true intussusception, but differing from the accident described under this name, chiefly in the pathological circumstance that it has its origin in œdema, inflammation, or hypertrophy of the mucous membrane, and sub-mucous areolar tissue.

Prolapsus of the rectum, in all its varieties, is much more common in infancy, childhood, and old age, than in middle life. With infants it is caused by protracted diarrhœa, ascarides, stone in the bladder, or by any of those causes which induce the child to strain. In old age it may be caused by straining to evacuate the bladder when the patient has a stricture, an enlarged prostate, or a vesical calculus, or by long-continued tenesmus. Its existence at any period of life is generally associated with ill-health, but we have seen some marked exceptions to this rule.

Fig. 382.



Prolapsus of the Rectum.

Treatment.—The primary cause having been ascertained and, if possible, removed, attention must be given to the regulation of the bowels, and to the improvement of the general health where a failure in these regards is manifest.

respects has somewhat the advantage of either of the others. The choice of the operation may, however, in this case be very properly left to the judgment of the surgeon.

Second, ablation of the protruding mucous membrane. This operation has occasionally been practised, and with some degree of success; but it is attended with too much danger from bleeding ever to be thought of except in cases of strangulation, and where the protrusion proves irreducible.

Strangulation of the Prolapsus.—This occurs pretty frequently with children; but very rarely with old people, in whom generally the sphincter has become too greatly relaxed to admit of strangulation.

The patient should be placed upon his back, with the hips elevated, and, having covered the gut with a piece of lint spread with cold cream, steady and continued pressure must be made with the hand. In some cases it will be made to retire more quickly if the ends of the fingers which grasp the prolapsed gut, press, at the same time, firmly against the margins of the sphincter; or the surgeon may try the effect of pressing with one or more fingers upon the pledget of lint directly over the centre, as if intending to thrust the fingers into the rectum. The internal use of chloroform will sometimes aid in the reduction. When other means fail it is considered justifiable to divide the external sphincter; and finally, in case this should not liberate the strangulated mass, and sloughing is imminent, the surgeon may remove one-half—more or less—of the swollen mucous membrane, including a large portion of the subjacent tissues. The chance that the muscular coats will be included is very small in these cases, and even if it is included, no harm necessarily results. The ablation being effected, several long and strong ligatures should be passed through the upper lips of the circular wound and brought out of the anus, as a measure of precaution in case the remainder of the gut should recede and bleed to such an extent as to render it necessary to bring the wound again into view.

Pruritus Ani, R. O.—The term pruritus ani is only indicative of a symptom common to several affections. It is often transient in its character; and is then usually due to a slight irritation of the mucous membrane caused by the expulsion of hardened or acrid fæces, or to the accumulation of the perspiration and other secretions between the nates. Relief is speedily obtained, in these cases, by frequent ablutions with tepid water and soap, and by mild astringents.

With children it is occasioned sometimes by *ascarides*, which may be found frequently nestling in the folds of the anus. These parasites are easily destroyed by injections of salt and water, lime water, or turpentine and sweet oil.

Eczema of the anus and adjacent tegumentary surfaces, like most forms of this affection, is in general exceedingly troublesome and obstinate. Washing the parts twice daily with hot water and castile soap seldom fails to give relief, and sometimes effects a cure. The red oxide of mercury ointment, diluted with an equal part of fresh lard, we have found serviceable. Dr. Van Buren prefers the "yellow wash" as a means of radical treatment; and he has found a liniment composed of one part of chloroform to eight of lard the most reliable means of allaying the nocturnal itching. But in most cases the general system is at fault, and no permanent cure can be expected until this is rectified. We have known it to cease upon the suspension of the use of tobacco and of alcoholic stimulants.

According to the dermatologists, pruritus ani is sometimes due to a *parasitic plant*, whose spores become lodged in the epidermis, and which is most promptly destroyed by sulphurous acid of Squibb's preparation. The acid is first employed with equal parts of water, and subsequently it may be applied stronger if it does not cause too much irritation.

CHAPTER XVII.

SURGERY OF THE GENITO-URINARY ORGANS.

Congenital Defects of the Urinary Apparatus.

There may be an absence or imperfect development of the kidneys, the kidneys may exist with absence of the bladder and urethra; and in this latter case the ureters may open at the navel, into the rectum or upon the vulva. The bladder is sometimes very small, being merely a dilatation of the urethra; it may be double, in consequence of a more or less perfect septum traversing the median line. As a consequence of arrest of development, some portion of its posterior wall may be deficient, and the urine may escape through the rectum or vagina. None of these abnormities are capable of relief.

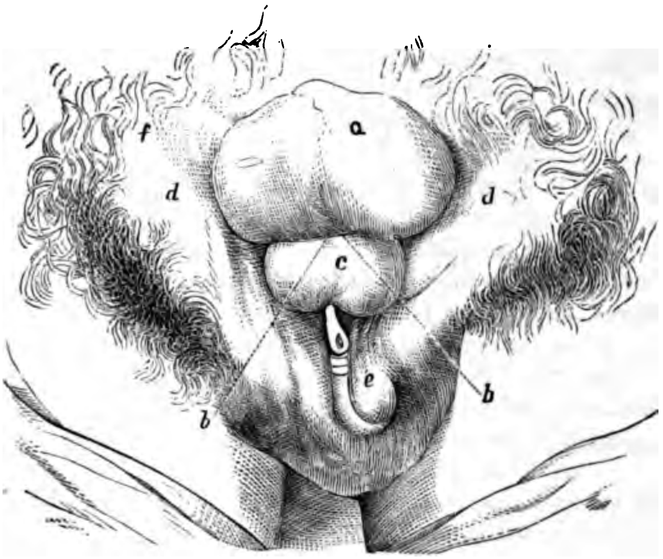
Exstrophy of the Posterior Wall of the Bladder. Syn., Membrana Vesicæ Posterior Foras Extrusa, R. C.

When the anterior wall of the bladder is deficient through arrest of development, the corresponding portion of the anterior abdominal parietes is likewise deficient; the posterior wall of the bladder, united to the abdominal parietes, forming an expanded and generally projecting mucous surface, upon which the ureters and the seminal ducts are seen to terminate. This condition is associated, usually, with imperfect development of the pubic bones, which are more or less widely separated, being connected only by an intermediate fibrous band. In the male, the penis is short, thick, and there is always epispadias. In the female,

toris is cleft in the same manner. The testes have descended in
ases, and in others they have not. The sexual desires are not
rily impaired in either sex; and several examples are recorded
regnation of the female. The umbilicus is either absent, or it is
d lower than usual. Inguinal herniæ usually accompany the mal-
ion, and various other abnormities are often found associated.

accompanying wood-cut illustrates the case of a patient well

Fig. 383.



Exstrophy of the Bladder.

to American students, and from whom I took a model in plaster
ears ago. *a*, represents the anterior surface of the posterior wall
ladder, thrust forwards by the pressure of the abdominal viscera;
orifices of the ureters, concealed between the bladder and the
of the penis, but which are at once brought into view when the
is lifted ; the orifices of the seminal ducts lie in the same fold;
; *d*, *d*, anterior termination of pubic bones; *e*, scrotum; *f*, a
tal inguinal hernia.

igneau, d'Autagnac, has furnished a very complete monograph
s subject, including a record of 87 cases; of which number 60
ales, 22 females, and in 7 the sex was undetermined.[1] Of the
en by myself, all were males. Several cases, additional to those
by Vigneau, may be found in Gurlt's Jahresbericht. The dura-
ife does not seem to have been influenced perceptibly by the
of the abnormity. In one case the subject lived to be 70
age.

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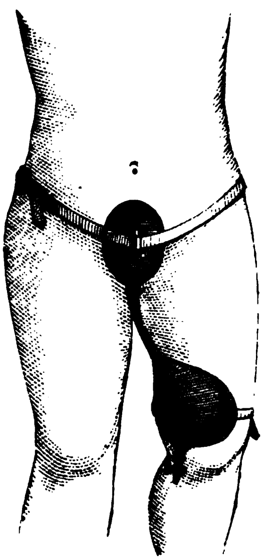
[1] *De l'Extrophie de la Vessie*; par. M. Vigneau, Montpelier, 1866.

ject, to deter any surgeon from future attempts to remedy a deformity so serious and disgusting. The purpose has been only to prevent too sanguine anticipations. I have myself urged several of these sufferers to submit to an operation at my hands; but having already informed themselves fully as to what have been the usual results, or, having listened to a fair statement to them of my own expectations, they have always promptly declined to permit any operation to be made.

Fig. 384.



Shield and Urinal for Exstrophy of the Bladder.

It is with much satisfaction, however, that I am permitted to inform my readers in what manner, by the use of a properly constructed shield and urinal, they may render the existence of these sufferers much more tolerable, if not actually comfortable. A gentleman who consulted me a short time since, found great comfort in the use of a metallic shield, constructed by Mr. Stollmann, of this city, to he lower extremity of which an elastic tube was attached, terminating in a pouch resting n the boot. According to McWhinnie,[1] a imilar instrument was employed by Mr. Earle, this latter being a modification of the one worn by a German traveller named Ussem, and figured by Duncan ome years before in the first volume of the *Edinburgh Medical and Surgical Journal.*

Epispadias. Syn., Fissura Epispadica Itineris Pectinis, R. C.

The urethral canal may terminate at any point of the upper surface f the penis, or the entire upper wall of this canal may be deficient, eaving only a superficial groove between the two lateral halves of the enis. This variety of abnormity usually accompanies exstrophy of the ladder, and seldom or never is the subject of surgical treatment.

Hypospadias. Syn., Fissura Hypospadica Itineris Urinæ, R. C.

Hypospadias, due in most cases to arrest of development, is a defect n the lower wall of the urethra. It is more frequently met with han epispadias; and inasmuch as the penis is generally in other respects olerably well developed, it is proper in certain cases to attempt its elief. Whenever the urethral canal terminates at the abnormal openng it will be necessary, first, to establish a channel, in imitation of the wound from side to side, in the direction of the circumference of the penis, with two or three fine sutures.

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[1] McWhinnie. Lond. *Med. Gaz.*, vol. x., New Series, p. 360, 1850.

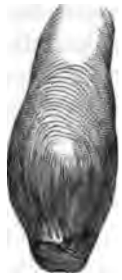
Phimosis, R. C.

Congenital phimosis exists occasionally to such a degree as to demand immediate interference; the preputial orifice being completely or almost completely closed. In such cases the surgeon ought not to be satisfied with a simple incision which shall give temporary relief, but he should proceed at once to make whatever operation may be required to insure in the future full and permanent immunity.

If the prepuce is simply contracted at its extremity, and not elongated, it will be sufficient to make a single longitudinal slit through the dorsal surface of the integument and mucous membrane. The precise method of procedure is as follows:—

Upon a grooved director, a narrow, sharp-pointed bistoury is carried almost to the point where the mucous membrane is reflected upon itself behind the corona glandis, and from thence it is thrust forward through the integument and brought out. If, as is sometimes practised, this operation is made with scissors, the mucous membrane is seldom cut to an equal extent with the tegumentary surface. Any vessels which continue to bleed should be carefully tied. I have known a neglect to do so, in the case of a child a few months old, result in a nearly fatal hæmorrhage.

Fig. 388.



Congenital Phimosis.

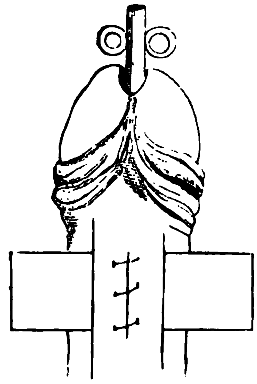
A more speedy cicatrization of the wound will now be insured by attaching the mucous to the tegumentary surface along each margin, with delicate sutures.

In case the prepuce is preternaturally long as well as contracted, the operation of circumcision may be made. Instruments are sometimes employed for holding the prepuce, which are intended to serve as guides to the knife, and as a protection to the glans penis. An ordinary dressing forceps will serve the purpose, if any instrument of this kind is needed; but the method of operating which has given me most satisfaction, whether in the infant or adult, has been to introduce through the preputial orifice a vulsellum, or a strong pair of toothed forceps, and, seizing the mucous membrane opposite the corona, to draw it well out. Committing the instrument to the hands of an assistant, with a second pair of forceps the mucous membrane is seized upon the opposite side of the prepuce, and this also is given to the assistant, who draws upon both pair of forceps steadily while the operator draws the integument gently backwards. By this procedure the mucous membrane is advanced beyond the tegumentary surface and is certain to be excised to an equal extent. While the parts are thus held the surgeon, with a knife or a pair of strong scissors, cuts somewhat obliquely the prepuce; the direction of the incision being from above downwards and natural urethra, through the corpus spongiosum and glans penis; and subsequently the cloaca may be closed by freshening the margins, and closing the edges over a silver catheter already placed in the newly-formed urethral canal The surgeon should be advised, however, that nothing but the most extreme care, with patient perseverance, is likely to be crowned with success in these cases, and that he must not be greatly disappointed if all his efforts result in complete failure.

Nélaton recommends that after freshening the edges of the opening, and lifting by free dissection the adjacent skin, two lateral incisions shall be made to relieve the tension, and a slip of India-rubber placed underneath the flaps to protect them from the urine.

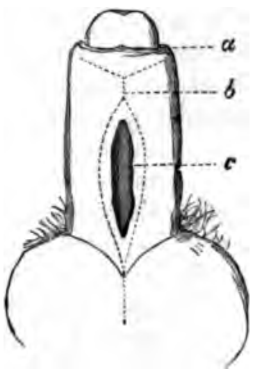
Le Gros Clark makes still more extensive dissection of the integument, uniting the longitudinal with transverse incisions, by which means he is able to bring portions of the under surfaces of each flap into contact, instead of the narrow, tegumentary margins. He then closes the portion of the wound corresponding to the fissure with Sims' metallic clamps.

Fig. 385.



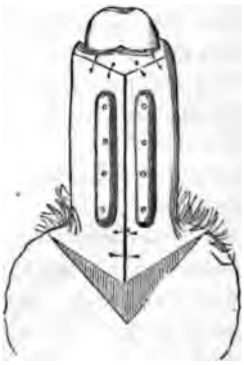
Urethroplasty. (Nélaton.)

Fig. 386.



Urethroplasty. (Clark.) Incisions.

Fig. 387.



Operation completed.

Ricord suggests that in case of a *penile fistula*, where no perineal fistula exists, which might serve as a diverticulum, it would be proper to puncture the bladder from the rectum, and maintain the urinary discharge in this direction until the penile fistula was cured; after which the vesical fistula might be left to close of itself.

Shortening of the Frænum.

Either as a congenital abnormity, or as the result of the irregular cicatrization of a chancre, the penis is sometimes bridled by the frænum, so that it assumes a dorsal curvature during erection. I have given relief in several examples of this kind, by cutting the frænum, and, after separating the edges freely by traction upon the glans, closing the

Epithelioma of the Penis. Syn. Epithelioma Colis, R. C.

Epithelioma occurs upon the penis in most cases as minute warty or papilliform growths, usually situated beneath the prepuce and in the vicinity of the corona. Of eight cases which have been observed by me, five occurred in persons having congenital phimosis.

Epithelioma of the penis may be distinguished from a syphilitic wart by the absence of a syphilitic history, by its slow growth and broad base; and finally by its tendency to ulceration. Venereal warts occur at all periods of life; while cancerous warts are seldom seen except in advanced life, or after the thirtieth or fortieth year. Venereal warts are generally multiple; cancerous warts are almost always single.

The only remedy is amputation, in case the glans or the body of the penis is involved. If, however, the disease is limited to the prepuce, as is very seldom the case, it might be sufficient to remove it alone.

Amputation of the Penis. Syn., Amputatio Colis, R. C.

This operation may be made with an ordinary bistoury. The integument should be drawn well forwards to avoid leaving a redundancy. After the amputation five arteries may require the ligature, namely two dorsal, two lateral, and one artery of the septum; and in some cases, the wound continues to bleed quite freely from the cellular structure even after these arteries are tied. In such cases search must be made for the urethra, which will be found retracted and buried within the corpus spongiosum; where it may be seized with a pair of mouse-tooth forceps and brought forwards. A female silver catheter must then be introduced into the bladder, so that the stump of the penis may be compressed by a bandage without interfering with the flow of urine. The danger and trouble from hæmorrhage is increased greatly when the penis is amputated near the pubes, and the stump retracts into the perineum. It is a prudent precaution in such cases to transfix the penis posterior to the point of amputation with a strong silver or silk ligature; which may be permitted to remain several days or until all danger of secondary bleeding is past; and by means of which the bleeding stump may be brought into view whenever it becomes necessary.

The écraseur has been employed by myself twice in amputation of the penis, while I have five times amputated with the knife. In neither of the amputations by the écraseur was it necessary to tie a vessel, and the wounds closed speedily. In nearly all the amputations with the knife the bleeding has been troublesome, and in one or two cases alarming.

During the progress of cicatrization, care must be taken to keep the orifice of the urethra well open, by the daily introduction of bougies, commencing from about the tenth or fourteenth day after the amputation.

Scirrhus of the Penis. Syn., Scirrhus Colis, R. C.

Scirrhus of the penis is exceedingly rare. I have met with only one example; which occurred in an old man, commencing as a hard, knob-like induration in the fibrous envelope of the corpora cavernosa. Such an induration must not be confounded with the simple, circumscribed "chronic indurations" which sometimes occur in the corpora cavernosa. If the disease has not progressed too far, amputation may at least delay the fatal event.

Herpes of the Glans, or of the Prepuce (Non-venereal).

This affection is characterized by small vesicles, which occur in groups; or by superficial excoriations. Some persons are liable to herpes from very slight provocations, and it often leads to a suspicion that syphilis has been contracted. Frequent ablutions with soap and water will generally prevent its recurrence; and in slight cases the same remedy will sometimes effect a cure; but mild astringent washes, such as the oxide or sulphate of zinc, the superacetate of lead, and nitrate of silver, act more promptly, and are, in general, more efficient.

Vegetations, or Warts upon the Penis.

Papilliform growths occur frequently upon the glans penis and upon the prepuce as sequelæ of chancres, of balanitis or posthitis, of eczema, and sometimes they occur where none of these affections have preceded. They cannot, therefore, be regarded as specific in their character, unless they are of the nature of epithelioma, already described. Occasionally they are seen growing from within the orifice of the urethra.

The treatment is purely local, and consists in the application of mild caustics and astringents, such as the chromic acid or the persulphate of iron. Sometimes, when the pedicle is quite small, the cure may be expedited by clipping them off with scissors, and then applying the caustics.

Polypi of the Urethra.

The interior of the male urethra is occasionally the seat of a small polypoid growth, resembling in structure the polypi which have already been described as occurring in the ear. They are soft and vascular, usually having narrow and elongated pedicles. Mr. Thompson states that they never occur except in the prostatic portion of the urethra. They may be removed by the ligature, or caustic.

Stricture of the Urethra. Syn., Strictura Itineris Urinæ, R. C.

Spasmodic Stricture.—An urethral stricture may be due, in part at least, to a spasmodic contraction of those unstriped involuntary muscular fibres which, according to recent investigations, surround the mucous membrane of the urethra in its entire length. It is probable, moreover, that the voluntary fibres which compose the compressor urethræ may cause a temporary stricture in the membranous portion; and possibly, also, the acceleratores urinæ may in a like manner constrict the bulbous portion of the urethra.

It is no doubt exceedingly rare that the surgeon meets with a pure, uncomplicated spasmodic stricture—perhaps never; but there are many cases in which muscular spasm constitutes the essential and predominating feature, especially in such as are caused suddenly by the excessive use of alcoholic liquors, but more particularly in such as are due to over-indulgence in acid wines; and in nearly all cases of organic stricture when the urethra is morbidly sensitive, the attempt to introduce the catheter or the sound rapidly, seldom fails to render the stricture more obstinate by inducing muscular contraction.

Treatment.—A brisk cathartic of sulphate of magnesia, which shall empty the bowels promptly and thoroughly, followed by alkalies when the urine has an acid reaction, and a full opiate, are measures of relief always deserving a trial. In many cases half a grain of morphine alone will give complete relief in the course of a few hours. If the catheter is used a large-sized instrument should be preferred, and it should be introduced slowly, waiting patiently for the spasm to cease whenever any obstruction is presented.

Inflammatory Stricture.—A purely inflammatory stricture may occur as a consequence of gonorrhœa, or of stimulating injections employed for its relief. In short, urethritis, from whatever cause developed, may induce such a degree of swelling of the mucous membrane, and the submucous tissues as to prevent the escape of urine.

Treatment—Venesection, leeches to the perineum, saline cathartics and the warm bath may hasten the subsidence of the swelling; but in these cases, also, as has already been intimated, muscular spasm often occupies an important place in the production of the stricture, and a full dose of morphine will aid materially in the release of the imprisoned urine. The catheter can seldom be employed advantageously in these cases, but if it is used, the utmost care and gentleness must be exercised in its introduction.

What has been termed *congestive stricture*, differs from that which we have named "inflammatory," rather in degree than in type. It may be properly considered as a subacute inflammatory condition of the whole or of limited portions of the urethra, which may be occasional or transient, or it may assume a somewhat permanent character; and in the latter case it is pretty certain to end in the formation of an organic stricture. Introduction of steel sounds or of wax bougies, at intervals of a few days, constitutes the proper treatment. With the utmost care in the use of the instrument, blood will sometimes be drawn, but this should not deter from the continuance of the practice.

Organic Stricture. Syn., Permanent.

The terms "organic" and "permanent" are applied to such strictures as consist of more or less completely organized structures or neoplasms, the results of inflammation, or of actual loss of tissue, with subsequent cicatrization, and which therefore possess considerable firmness, and offer serious resistance to the introduction of an instrument. They are never formed suddenly, unless ensuing upon traumatic lesions, or upon the cicatrization of chancres. Usually their progress is exceedingly slow and insidious, occupying many years in their complete development. Their most frequent seat is at the anterior extremity of the bulbous, or about one inch in front of the membranous portion. Through the entire length of the sinus of the bulb, until the membranous portion is reached, strictures are very common; but they continue to lessen in frequency in this direction, and when the membranous unites with the prostatic portion they are rare. Mr. Thompson, to whose careful observations we are indebted for these statements, has never found a stricture in the prostatic portion of the canal. They are quite frequent in the fossa navicularis, and at the external meatus, but rare between the fossa navicularis and the bulb. They may be single or multiple. In form they are exceedingly varied, in certain cases being circular, surrounding the entire canal; in others they are limited to one side only. When due to infiltrations and indurations of the submucous and spongy tissues, they extend some distance in the direction of the length of the canal; but when only the mucous membrane is involved, or the mucous and muscular tissues, they are usually short, and their free margins are tense and sharply defined, as if the canal was tied with a "packthread." In some cases they are composed of bands which stretch across the urethra in various directions, constituting the "bridle stricture." They may be irregular or tortuous; and indeed they may assume many other forms which it will not be necessary to enumerate.

Complete occlusion or obliteration of the canal seldom occurs. Even when a fistula forms above the stricture, more or less urine continues usually to escape through the whole length of the urethra.

Causes.—The usual causes of organic stricture are protracted urethritis, whether originating from gonorrhœa or from any other source. The low form of inflammation attending a long-continued gleet is almost certain to induce stricture; and when once the process of narrowing has commenced it is apt to continue long after the gleet and other palpable signs of increased action have ceased.

Traumatic Stricture, Syn., Strictura ex Vulnere, R. C., usually considered as a variety of organic, is the result of violence, such as a fall upon the perineum, or the unskilful use of sounds or catheters. It is therefore a direct consequence of inflammatory infiltrations, conjoined with loss of structure and contraction of the cicatrix, and is usually the most intractable of all the forms of stricture.

Symptoms.—The symptoms which indicate the approach or actual existence of an organic stricture are a long-continued gleety discharge, forked or irregular projection, with diminished size of the stream of urine, frequent desire to urinate, and delay in the expulsion, occasional sensation of uneasiness in the perineum, sometimes accompanied with smarting and soreness. The most satisfactory evidence, however, is obtained by the introduction of suitable instruments.

Pathology.—The pathological sequences of a permanent stricture are often serious. The urethral canal posterior to the stricture becomes dilated, forming a sinus or pouch, which sometimes can be distinctly felt during the efforts at urination. The membranous is less liable to this dilatation than the spongy or prostatic portions; consequently when the stricture is in the anterior part of the membranous portion the dilatation may not exist. Ulcerations and perforations take place, especially in the lower wall of the urethra, back of the stricture; abscesses result in consequence of the escape of urine, and eventually perineal fistulæ occur. The lacunæ of the mucous membrane posterior to the stricture, and the orifices of the ejaculatory and prostatic ducts, frequently participate in the dilatation; and the intermediate portions of the canal, especially along the floor and lateral walls, become converted into a sort of network, in which an instrument, having passed the stricture, might possibly become entangled. Abscesses may form in the prostate, or it may become degenerated into a soft pultaceous mass. The bladder becomes dilated and hypertrophied, or sacculated; its mucous membrane is kept in a constant state of irritation from detention and decomposition of the urine, causing a frequent desire to urinate. The ureters dilate enormously; the pelves, infundibula and calices of the kidneys undergo a similar enlargement, while the proper substance of the kidneys becomes atrophied, and finally the symptoms of uræmic poisoning ensue as a natural result of the failure of these organs to eliminate the effete matters of the circulation.

Exploration of the Urethra.—In order to determine the existence of a stricture, a well-polished steel sound, of the proper size and curve, may be first employed.

For this purpose a rather large instrument is always to be preferred. When by careful examination the existence of a stricture has been determined, the point of a smaller and somewhat conical steel sound may be made to enter the stricture by gentle and steady pressure, in order to determine its size and resistance; or the surgeon may substitute with advantage a metallic or India-rubber instrument terminated by a bulb, the extremity of which, having passed through the stricture, will again move freely. He will thus be able to determine approximately the length of the constricted portion. By conveying the instrument into the bladder, also, he can determine whether other strictures exist beyond the one first encountered. Indeed it is only with instruments of this construction that this important point can be decided. With the solid steel sound and the olive-shaped or bulbous bougies, a very large proportion of strictures may be thoroughly and satisfactorily examined. In case, however, the stricture is very tight, the surgeon will have to employ some form of elastic filiform bougie to complete the exploration.

Fig. 390

Olive-shaped Bougie.

Treatment of Organic Stricture.

There is no variety of stricture in which therapeutical means may not be employed to advantage. Even in that form now under consideration they cannot properly be omitted. While attempts are being made to overcome the obstruction by instruments, the patient should abstain from the use of stimulating liquors, and especially of acid wines; tobacco should be interdicted; all venereal indulgences should be forbidden, and the diet should be simple and unstimulating. But the measure which we have found of all the most efficient, is absolute confinement to the bed. As a rule, it can be safely stated that a stricture which may be cured in four months while the patient is about his ordinary business, may be cured in two months in bed.

Gradual Dilatation.—The instruments which I usually employ for this purpose, are solid steel sounds, flexible gum-elastic bougies—both of which should be slightly conical at their extremities—and filiform bougies.

Commencing, in most cases, with a steel instrument larger than will be admitted into the stricture, it is introduced daily with great care, for no other purpose than to abate the sensibility of the canal. If practicable, it is better not to introduce it soon after urination, when the irritability of the channel is generally somewhat increased. The plan recommended by Mr. Thompson, of throwing in a little sweet oil with a syringe before introducing the instrument, is excellent. When the sensibility of the urethra has been somewhat diminished, an instrument is selected whose conical extremity may be made to enter the stricture a few lines, which will sometimes be recognized by its being grasped slightly when an attempt is made to withdraw it. From this time the progress may be slow or rapid, but it is certain. Whether the sound should be introduced daily, or once in two or three days, will depend upon the amount of pain or irritation which it occasions. Nothing is gained by haste in these cases. It has often happened to us to see cases in which no perceptible progress was made for three or four weeks, when unexpectedly, and with no unusual pressure, the instrument has slid easily into the bladder. In order to insure success the dilatation should be continued until the size of No. 12 or 14 is found to pass without resistance. The patient may then be considered cured, so far as a cure is possible in these cases; for it must be understood that in whatever manner the relief of the stricture has been effected, whether by dilatation or by rupture, by caustic or incision, the result is the same—the stricture will inevitably return unless the use of instruments is continued. Once a week, during the remainder of his life, the patient must introduce a sound or catheter of the size of No. 12, or he may confidently anticipate, sooner or later, a renewal of all his troubles.

Steel sounds are generally more manageable, and they are therefore usually preferred to flexible instruments; but no practical surgeon confines himself to any single form of instrument. There are many cases in which the first step of progress, especially, demands the use of the filiform bougie; and in introducing this instrument much patience is required, in order that by turning and variously manipulating the point of the instrument it may be successfully engaged in the stricture. Neither gutta-percha nor laminaria, lately suggested for the dilatation of strictures, can be safely employed, on account of their friability.

To the question so often repeated by inexperienced surgeons, "What proportion of organic strictures can be successfully treated by gradual dilatation?" we answer unhesitatingly, almost every stricture into which the smallest sound or bougie can be introduced. And to the question which naturally follows, "Are there any strictures through which urine can pass which cannot be entered by instruments?" we reply that we have seldom or never met with them; and that such examples must at least be exceedingly rare. It is not pretended that all strictures of this class can be entered at once; but only that with patience, perseverance, and skill, within a few weeks or months at most, they will in all probability yield to the instruments, and the bladder will be safely entered. We have recently had a gentleman under care, with an old organic stricture, in whose case no instrument could be made to pass or enter the stricture during eight weeks that he remained in bed, when suddenly one morning a No. 4 became engaged to the extent of an inch or more, and after six weeks' further confinement he returned to his home cured, and using easily a No. 14.

It is an error to suppose that a stricture treated by caustics or incision is cured any more thoroughly than when it has been treated by dilatation, or, as it might more properly be called, by absorption. There is no soundness in the theory upon which the claim is attempted to be sustained; and there is no experience to justify the assumption. We have observed the results of all these forcible methods in many cases; and there is the same tendency in all of them to a return of the stricture, unless the dilatation is afterwards maintained by the occasional and regular introduction of instruments.

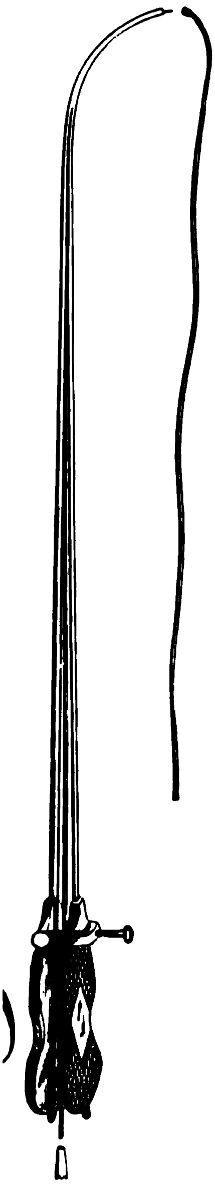
The only objection that can be offered to gradual dilatation, then, is the length of time it may require to complete the cure, as contrasted with forcible dilatation, caustic, incision, and perineal section; but on the other hand it cannot be denied that in point of safety, gradual dilatation has greatly the advantage. Death is seldom or never a result of the latter procedure; but from all that we have seen and heard of the other methods, they are followed by a mortality equal to five or seven per cent. Nor does it seem to vary much whether caustic, internal incision, forcible dilatation, or perineal incision have been employed. Indeed, some gentlemen of large experience, who favor frequent incisions, admit a mortality of not less than seven per cent., and regard it as flattering testimony to the excellency of their practice, because in very many surgical operations which are deemed justifiable, the mortality is twenty-five or even fifty per cent. The fallacy of the argument is too apparent to require exposure. If one is convinced, however, that the condition of the patient demands speedy relief, or if it should happen that the stricture will not yield to gradual dilatation, the surgeon may resort to some one of the other methods already named, and which we shall now proceed to describe.

Rapid or Continuous Dilatation.—This term has been applied to a method of dilatation occasionally practised, which consists in retaining the catheter or the sound in the urethra for several consecutive hours, and substituting each time on its removal a somewhat larger instrument. In this way it is possible, in certain resilient strictures, to accomplish a rapid dilatation, but not without the hazard of causing ulceration of some portion of the canal, and of inducing violent urethral fever. The method has therefore very little to recommend it to the surgeon's favor, perhaps nothing beyond the fact that the stricture can in this way be more speedily overcome.

Forcible Dilatation, or Rupture of the Stricture.—For this purpose Mr. Holt's instrument is now generally preferred. It is composed of a shaft split nearly to the distal extremity, enclosing a wire longer than the shaft of the instrument. The wire serves as a guide upon which tubes of various sizes may be projected, and by which the two portions which compose the shaft may be separated. When the rupture of the stricture is effected, the instrument is closed and withdrawn. The bladder should then be emptied by a full-sized catheter, the patient placed in bed, and a mild opiate with quinine administered. The catheter must be introduced daily for several days or weeks.

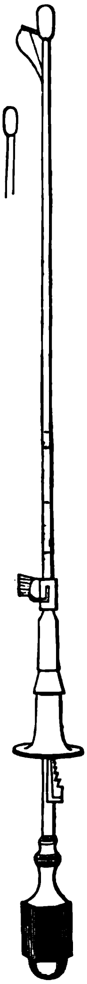
Internal Incision, or Division. Syn., Urethrotomia Interior, R. O.—There are few, if any, surgeons who would now recommend internal incisions when the stricture is as far back as the bulb of the urethra; but in my day they have been practised a good deal in whatever part of the urethra the stricture might happen to be. Indeed, it was quite the fashion, twenty-five years ago, to cut all strictures by internal incisions; but the male urethra is neither so straight nor so insensible as a rifle bore, and surgeons soon learned this, and then for ile, or until another generation grew up, it was treated with more ct. Internal division is reserved at present among experienced surgeons for strictures of the spongy portion of the urethra, and in front of the sub-pubic curve; and especially for strictures of the meatus. At the meatus, an ordinary probe-pointed narrow bistoury will answer. For the division of strictures lying more deeply in the canal, a great variety of instruments have been devised, among which may be mentioned the urethrotome of Civiale, Charrière, Maisonneuve, Henry Thompson, Peters, Westmoreland, Gouley, and Otis.

Fig. 391.



Instrument for Rupture of Stricture.

Fig. 392.



Civiale's Urethrotome.

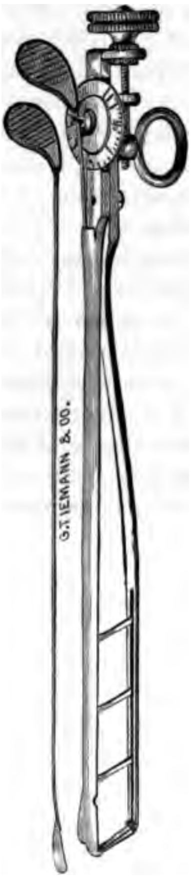
Most of the instruments are intended to divide the stricture by cutting from behind forwards, and they cannot be used, therefore, except when the stricture is passable. The bulb at the extremity of Civiale's instrument is of the size of a No. 5 catheter; but an instrument invented by Mr. Thompson, as well as that devised by Dr. Peters, are much smaller.

It is not prudent in any case to make deep incisions by internal urethrotomy, on account of the danger of bleeding, and of causing urinary infiltrations which may lead to the formation of abscesses and fistulæ. For this reason the blade of the urethrotome ought never to project more than four-tenths of an inch. In Dr. Peters' and Mr. Thompson's instruments the projection is less than this.

Cutting a stricture from before backwards, by internal incision, is attended with so much danger of thrusting the knife into the walls of the urethra that it ought never to be practised except when the stricture ar the end of the penis; or unless the surgeon, being furnished with strument having a guide, has made himself certain that the point e instrument has well entered the stricture before he pushes the e forwards.

It will not be out of place for me here to call attention to an excellent paper read by Dr. Ambrose L. Ranney before the New York Academy of Medicine, June 17, 1880,[1] entitled "Are the benefits to be derived from internal urethrotomy commensurate with its dangers?" Dr. Ranney quoted, as having answered this question more or less distinctly in the negative, Sir Henry Thompson, Spence, Erichsen, Gross, Van Buren, Keyes, Gouley, Bumstead, and Sands. In the discussion which followed, similar opinions were expressed by Dr. Burchard and myself.

Fig. 393.



Otis' Divulsor and Urethrotome.

Dr. Ranney referred to numerous statistical records and special observations, to show that the operation, especially as practised and recommended by Dr. Otis, had in very many instances caused death from uræmia, pyæmia, shock, hæmorrhage, infiltration of urine, abscess, and gangrene. Deformity of the penis has also resulted, and patients have been seriously incommoded by the incision of the meatus, which is often a necessary preliminary to Otis' operation.

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[1] Ranney, *New York Med. Gaz.*, July 17, 1880.

the *New York Medical Journal* for January, 1877, I notice that Dittel, of Vienna, prefers in all cases gradual dilatation to internal rotomy.

Fig. 394.

External Incision, or Division. Syn., External Urethrotomy; Perineal Section; Sectio Perinei, R. C.—The circumstances which demand or justify perineal section are the following:—First, recent traumatic strictures accompanied with extravasation of urine and complete retention; and in which delay may imperil life. In these cases the surgeon must elect between perineal section and cystotomy. Second, impassable organic strictures in any portion of the sub-pubic curve, that is, from a point one inch and a half in front of the bulb to the neck of the bladder. Third, organic strictures situated in the sub-pubic curve, which permit the passage of a small instrument, but do not admit of farther dilatation under gradual and long-continued pressure; or which having yielded for a moment, quickly and persistently return to their original state. The conditions assumed in the second and third varieties I have already declared to be exceedingly rare; but the existence of such strictures being determined, perineal section is a proper resort. Examples of the third variety may be treated either by forced dilatation or by perineal section. Fourth, strictures situated in any portion of the canal, accompanied with perineal fistulæ having callous walls; the fistulæ showing no tendency to close spontaneously, or after complete dilatation of the strictures. These constitute the
requent and the most appropriate cases for perineal section; but
ich as strictures, accompanied with these grave complications, are
now and then cured by gradual dilatation of the urethra, the
ion will not be justifiable until this latter method has been tho-
y tried. The operation is, under all circumstances, one of grav-
l ought not to be performed when the system is not in a tolerably
y condition, and especially when the patient is suffering seriously
ny form of renal affection.

Urethrotome, open.

**ration of External Urethrotomy when the Stricture is Im-
ble, and there is no Fistula.**—The patient is placed as in the ope-
for lithotomy, and anæsthetized. A catheter of medium size
introduced into the urethra, and carried down to the stricture.
cision is now made in the median line upon the end of the
r, prolonging the incision backwards until the dilated portion of
nal back of the stricture is entered. Some surgeons prefer to
the dilated portion first, and proceed forwards. Whichever
l is adopted, the operation will demand more skill and patience
lmost any other in surgery. The bleeding in perineal section is

generally quite free, and the vessels are not easily secured; and in the midst of the indurated tissues it is difficult to keep in the median line and to observe the relative position of parts. Two rules I have found of practical importance in all operations of perineal section: one is, not to cut while there is so much bleeding as to obscure the parts and render the direction of the incisions uncertain; the other is not to thrust the finger into the wound often, if at all, certainly never violently, since it is apt to dissect the more superficial tissues, and to leave the surgeon to suppose that he is approaching the urethra, when he is in fact approaching the bladder, thus exposing to incision the deep perineal fascia. As soon as communication is established between the portions of the canal situated at both extremities of the stricture, the catheter must be carried on until it enters the bladder, when the operation is completed.

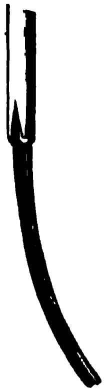
Operation of External Urethrotomy, when the Stricture is Impassable, but there exists an External Fistula.—In all cases of this kind the surgeon is advised to explore the fistulous opening by careful and repeated examinations, until he has been able to introduce an instrument by this channel into the bladder. He should then proceed to shorten the route of this canal by incisions, and widen it by gradual dilatation, until it is reduced to the simplest possible condition, and until its course and position are thoroughly understood. It is now possible, in a few cases, by introducing a curved probe, to explore the cul-de-sac, which often exists between the point where the fistula terminates in the urethra and the stricture, and thus to acquire a more exact knowledge of the seat and length of the stricture.

These preliminaries having been observed, the operation will be made in the same manner as for an impassable stricture without a fistula, only that the surgeon may now guide his knife in some degree, if he deems it necessary, by an instrument carried through the fistula into the bladder, or by a bent probe carried from the fistula toward the stricture.

External Urethrotomy, when a Filiform Bougie or other small instrument can be carried through the Stricture into the Bladder, whether with or without a Fistula.—Mr. Syme has declared that in any case in which urine escaped through the stricture, and by the natural channel, it would always be found possible to introduce through the same channel some form of instrument into the bladder; and if he was not absolutely correct in this statement, he was so near the truth that the surgeon may seldom expect to fail, provided he exercises patience and skill; and if he succeeds, he will be able to substitute a comparatively simple operation for a very difficult one, inasmuch as he will now be furnished with a reliable guide for his incisions.

The operation may be made with no other guide than that furnished by a filiform bougie; but a bougie of this size cannot be felt in the urethra, even when the incision is close upon it; and it is only of use when, by careful dissection upon a dry wound, it can be seen. The surgeon should therefore either project upon the bougie a metallic cylinder, carrying the latter down as far as the stricture, or he should withdraw the bougie and introduce a staff, having a slender grooved extremity, of the size of No. 1 or 2 catheter scale, while the shaft of the instrument is equal to No. 8. Mr. Thompson has constructed a staff which is hollow, in order that he may be informed when the beak of the instrument has entered the bladder, by the escape of urine. All danger of operating while the instrument rests in a false passage is thus avoided.

Fig. 395.



Staff for Perineal Section.

The patient placed in the same position as already described for other perineal sections, the shoulder of the staff being pressed well against the stricture, the operator cuts slowly and carefully in the median line upon the convex surface of the staff, the deeper portions of the incision extending from the shoulder of the staff to a point one inch, more or less, backwards. Care must be taken not to carry the incision beyond the deep perineal fascia. To avoid this accident, Mr. Syme advises cutting from behind forwards; but this is an awkward mode of handling the knife, and does not appear to me any more safe. The stricture being divided, the catheter is introduced and permitted to remain. In case the surgeon experiences difficulty in introducing the catheter beyond the wound, he may generally succeed by carrying through the wound into the bladder a large straight-grooved director, to serve as a guide.

The catheter should be permitted to remain in the bladder twenty-four hours, and then withdrawn, and after the lapse of seven or ten days it should be introduced daily, in order to insure a sufficient dilatation of the canal; no catheter or other instrument should remain permanently in the wound after the first twenty-four hours.

Treatment of Strictures by Caustic.—Caustics have been employed in two conditions of the stricture:—First, when the instrument is completely arrested, as by a bulkhead. Under these circumstances a piece of the nitrate of silver of the size of a large pin's head, or a small piece of potassa fusa is embedded in the end of a wax bougie; the bougie is then carried rapidly down to the stricture and pressed firmly upon it for the period of one or two minutes, when it is withdrawn. This may be repeated every three or four days if necessary. Liston called the practice "most atrocious," and, considering the liability there must be to the displacement of the caustic, or of its application to the sides of the canal instead of the stricture, I agree with Liston in his appreciation of the practice. Second, when the instrument enters the stricture, but is unable to pass completely through. In examples of this class the caustic is usually conveyed to the stricture by a cylindrical instrument having a side fenestra. The caustic, mixed with simple cerate, is carried to the opening in this catheter-like instrument, by means of a rod projected through its centre. Milder caustics are also employed by some surgeons to abate the irritability of the stricture; and no doubt with occasional good results.

Electrolysis, as a means of cauterization and dilatation, recommended recently by Mallez, Bautista and others, is painful, uncertain, and liable to be followed by peri-urethral abscesses. It possesses no compensating advantages which entitle it to any farther notice.

Perineal Abscess. Syn., Abscessus in Perineo, R. C.

One of the most serious consequences of an organic stricture is perineal abscess, occurring sometimes wholly external to the urethral canal, as a consequence of the propagation of inflammation; but in a large majority of cases ensuing upon an ulceration of the mucous membrane, and the consequent escape of a few drops of urine. It is in general easily recognized as a small, circumscribed tense swelling situated between the scrotum and anus, at first enlarging very slowly, and not causing much if any suffering; but after a few days the swelling commences to increase rapidly, and is accompanied with great pain, tenderness, and general febrile disturbance.

Treatment.—Early and free incision along the median line is the only proper resort. Whether the swelling shall prove to have been caused by the escape of urine or not, and even although no pus may be found, the incision can do no harm, while in the opposite case it will prove eminently serviceable. After the incision has been made, the patient must be placed in bed and a soft warm poultice applied. We have seldom found it useful, under these circumstances, to introduce a catheter subsequent to the operation; but the decision of this point may properly be left to the judgment of the surgeon.

Extravasation of Urine. Syn., Suffusio Urinæ, R. C.

Sometimes as the result of a stricture, but more often in consequence of a blow upon the perineum, there is a sudden and extensive extravasation of urine into the cellular tissue of the scrotum and adjacent portions of the body, accompanied with great and rapid swelling, gangrene, and violent constitutional disturbance.

Treatment.—The integument and areolar tissue involved must be at once laid open by numerous long and deep incisions, and carbolic acid or yeast poultices applied.

Perineal Fistula. Syn., Fistula in Perineo.

It has already been stated that a certain number of these fistulæ may be successfully treated by overcoming the stricture which was the original cause of the accident, and upon which its continuance now mainly depends. At the same time, also, that the urethra is undergoing dilatation, the surgeon may expedite the closure of the fistula by the occasional application of the nitrate of silver or of other caustics, to the callous edges of the canal, thus encouraging the formation of granulations and exciting contraction. When much time has elapsed after the complete dilatation of the stricture, and the fistulous orifice still remains, it will be proper to resort to some one of those operations elsewhere described under the name of urethroplasty.

Catheterism for Relief of Retention of Urine in the Male.

Retention of urine, rendering it necessary to employ a catheter, occurs in consequence of some one of the several forms of stricture already described, from enlargement of the prostate, or from paralysis of the bladder.

The instruments employed for catheterism are metallic and gum-elastic catheters of various sizes and forms, according to the exigencies of the case; and no surgeon is properly supplied with instruments for this operation who has not at least half a dozen at his command. For this reason I have never permitted a catheter to be placed in my pocket-case A single catheter of the size of No. 8 may serve in a great number of cases, and the country practitioner may find it convenient to have such an instrument with him, especially for the purpose of catheterism in the female; but it would be better for his patients if, even for the exigencies of a country practice, he always carried with him a complete set of instruments. The temptation to use an unsuitable instrument is very great when the patient is suffering from retention, and no suitable instrument is at hand; but the truth is, that, as a rule, it would be better for the patient to wait many hours, rather than that a catheter too large or too small, or of an unsuitable curve, should be employed. To this cause, quite as much as to a lack of skill, is to be ascribed the numerous examples of false passages and other injuries caused by catheters with which we constantly meet. In this city certain druggists, and all sorts of empirics supply themselves with a single silver catheter, and practise upon such unfortunate sufferers as call upon them. Their patients, I have observed, are generally only those who have a temporary occlusion of the canal occasioned by a debauch, or they are old people who have enlarged prostates, and whose bladders have been weakened by holding the water too long, and in whom catheterism is not usually difficult; yet I believe they manage to " tunnel " the urethra in about one-half of their cases.

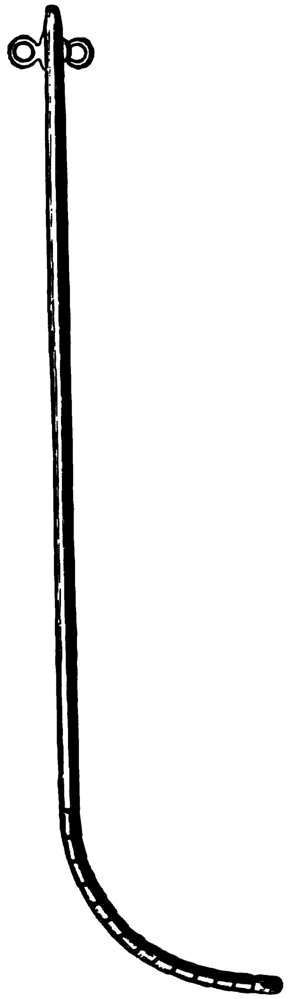
In cases of retention from spasmodic stricture, occurring in the adult, a medium-sized silver catheter is generally to be preferred. In paralysis of the bladder, also, unaccompanied with stricture or enlarged prostate, as for example when the spinal cord has been injured by a fall. a medium or full-sized instrument is the best. If the patient is suffering from organic stricture, a smaller instrument will be required, and the surgeon will decide upon the form, size, and construction which will be most suitable, by trial. When the prostate is enlarged, if a metallic instrument is used it must have a long and abruptly curved beak. Some surgeons prefer catheters made of pure silver, which permit the form of the beak to be changed by bending; but if frequently bent they soon become indented, and the size of the cylinder may be sensibly diminished by encroachment of the walls. In most cases, however, in which the prostate is enlarged, and in some other cases where the cause of the arrest of the instrument is not so easily explained, the flexible gum-elastic catheter is to be preferred.

In general the supine position is the best for the introduction of a catheter, with the shoulders a little raised and the legs drawn up. The operator, standing upon the left side of the patient, holds the instrument with his right hand, and with the left raises the scrotum and penis. At first the shaft of the catheter should incline toward the left groin, but as it descends along the urethra it must be brought gradually to the median line of the body, and slowly elevated as the beak passes under the pubes. If at this point the instrument is arrested, it is probably because the beak is pressing upon the floor of the sinus, in front of the membranous portion, and the instrument must be withdrawn a little and its handle slightly depressed, while the penis is moderately stretched to obliterate its folds. Too much depression of the shaft may cause the beak to rest against the triangular ligament, but the firm resistance offered by this obstacle is easily recognized, and the error is in general speedily corrected. In passing through the membranous and prostatic portions of the urethra the handle of the instrument falls over between the thighs, and if any resistance is offered it is caused by obstructions in the lower wall of the canal, and will be overcome by continuing to depress the handle and thus to elevate the beak.

It must be borne constantly in mind that the lining membrane of the urethra is exceedingly delicate, and that very little more force than the natural weight of the instrument is admissible; indeed this is all that is usually required. As more or less spasm is generally caused by the attempt to pass the catheter, success will often depend upon a few moments' delay when resistance is encountered, during which the spasm, which is always transient, will subside. Very gentle but steady pressure will hasten the relaxation of the spasm.

If, in a case of enlarged prostate, the silver catheter cannot be passed readily, the surgeon may employ to advantage a gum-elastic catheter, furnished with a pretty firm stylet, with which he may increase the curve to any desired extent. There is also a very simple expedient to which I have resorted in these and in many other cases, with remarkable success. Having dipped the end of the gum-elastic catheter in hot water to render it more flexible, it has been introduced to the obstruction and the stylet then withdrawn an inch and a half or two. By this manœuvre the end of the catheter is still more elevated, while it is so flexible as to assume any direction which the channel may happen to require. The outer end of the catheter is now seized and pushed down over the stylet, while almost at the same moment the stylet itself is gradually withdrawn. Care must be taken in adopting this method that the stylet is withdrawn, in the first instance, so far as to render it certain that its extremity cannot protrude from the eye of the catheter.

Fig. 396.



Squier's Prostatic Catheter.

Dr. T. H. Squier, of Elmira, N. Y., has had constructed a silver catheter, designed especially to be employed in cases of enlarged prostate. The instrument is like the ordinary silver catheter, except that the vesical extremity is made flexible by being composed of imbricating and movable sections. I have employed this instrument in a few cases, and have found it to answer its purpose exceedingly well; but, notwithstanding the assurances given by the inventor, it is impossible to divest one's self of an apprehension that the links may become detached and remain in the bladder. Nélaton's vulcanized gum-catheter, known as the soft catheter, is safer and in every respect preferable where a very flexible instrument is required.

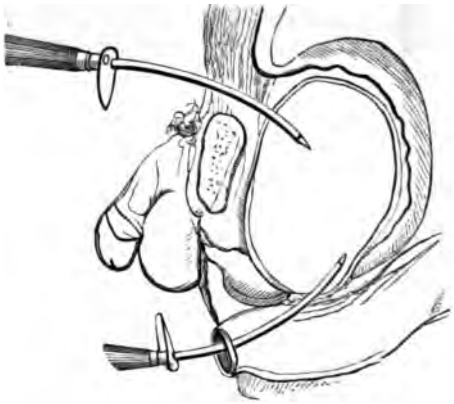
Cystotomy. Syn., Paracentesis Vesicæ, R. C.

Paracentesis of the bladder has occasionally been found necessary when all other means have failed for the relief of retention of urine. The surgeon must not be in haste, however, to resort to what must always be considered a grave operation. It is remarkable to what an extent the bladder may sometimes be stretched without causing a rupture of its walls, or even anything more than a temporary paralysis; indeed I have seldom seen it ruptured from this cause, although I have often found it rising some distance above the umbilicus, giving to the belly the appearance presented by a woman several months gone in pregnancy. What is more remarkable, and the knowledge of which is of even more practical value to the surgeon, is that retention of urine is very rarely so complete or so persistent as to render it necessary to open the bladder. Either the urine continues to dribble away in sufficient amount to give some relief, or, under proper therapeutical treatment, often after the rest obtained by a full dose of morphine, the urine escapes again freely, and complete relief is obtained. The bladder may be entered through the perineum, through the rectum, or above the pubes.

Cystotomy through the Perineum.—Cystotomy by perineal incision is, in most cases, essentially the same operation as that already described as perineal section; the purpose being to afford an outlet by entering the urethra back of the point of stricture rather than by an incision directly into the bladder. The depth and direction of the incision must, however, vary according to the seat of the stricture; and if an enlargement of the prostate is the cause of retention, the operation would correspond to the perineal operations for lithotomy, only that it must be performed without a guide.

Cystotomy through the Rectum.—The patient resting upon his back, with the legs drawn up, the surgeon explores carefully the bas-fond of the bladder with the forefinger of the right hand in the rectum, in order that he may determine the position and size of the prostate gland, and the most salient point of the bladder, which is usually about the centre of the vesical triangle. A long curved trocar, the point of which is concealed in its canula, is now held in the right hand, the index finger projecting beyond its extremity, and carried to the vesical triangle, especial care being taken that the point of the instrument is not placed so high as to endanger the recto-vesical fold of the peritoneum. Indeed it will be most prudent not to carry the point of the instrument more than half an inch above the prostate. While the instrument is held firmly in this position the trocar is thrust forward with the left hand, and immediately withdrawn, leaving the canula in the bladder.

Fig. 397.



Cystotomy above the Pubes and from the Rectum.

If it becomes necessary to keep the orifice open several days, it will be proper to substitute for the canula a gum-elastic catheter, which will be easily introduced by carrying it through, and then withdrawing the canula. When no instrument is permitted to remain in the wound immediately subsequent to the operation, and even when the instrument is withdrawn only after the lapse of several days or weeks—if, in the meantime, the urethral canal is restored—the wound in the bladder generally closes very quickly.

Cystotomy above the Pubes.—An incision is made in the median line, just above the pubes, between the pyramidalia and recti until the bladder is fairly brought into view. The bladder is then punctured with a long trocar and canula, the canula is thrust forward and the trocar withdrawn. There is considerable danger in the operation that the urine may find its way into the loose areolar tissue outside of the peritoneum, an occurrence which is almost inevitably fatal. In some cases the aspirator can be advantageously substituted for the trocar and canula; in the employment of which no preliminary incisions are necessary.

The operation through the rectum is more easily performed and is comparatively safe, and ought always to be preferred unless some condition of the rectum or of the prostate should seem to render it unsuitable. It is certainly a safer and more surgical operation than forced catheterism, or "tunnelling" the prostate gland, as recommended by Liston.

Incontinence of Urine.

In the case of children, and sometimes in the case of adults, the habit of involuntary urination during sleep is due to abnormal irritability of the neck of the bladder. It may be prevented, in most cases, by careful attention to the diet and to general hygiene; by the use of mineral tonics, and by enjoining upon the patient not to sleep upon the back; in which position the urine accumulates in the bas-fond, and near the neck of the bladder, occasioning a desire to urinate. The remedy, how ever, which my own experience and the experience of others has proven to be most useful, is the extract of belladonna, in doses suited to the age of the patient. Where all other means fail, the patient must make it a rule to rise once in the night and evacuate the bladder.

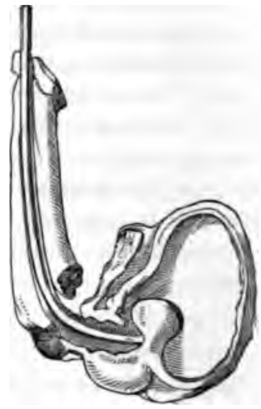
We frequently meet with examples of incontinence, or more properly of "overflowing" of the bladder, due to over-distention; in which the water is constantly dribbling away in small quantities, and which sometimes, greatly to the injury of the patient, have been mistaken for true incontinence. This condition depends upon a variety of causes, but most often upon atony of the bladder. It is more frequently observed in women than in men. Whenever a doubt exists as to the true character of the incontinence, a catheter should be introduced in order to establish the diagnosis and to relieve the viscus if it is found to be distended.

Chronic Enlargement of the Prostate. Syn., Amplificatio Longa Prostatæ, R. C.

According to the observations of Sir Henry Thompson, the prostate has been found appreciably enlarged in men who have died after the sixtieth year, in 34 per cent. of all the cases; but such a degree of enlargement as occasioned urinary obstruction during life existed in only 15 or 16 per cent. of the whole number.

In general the hypertrophy is exceedingly slow and uniform in its progress, and implicates all portions of the gland alike. In other and exceptional examples, either one of the lateral or the central lobe may be alone involved. It may attain the size of a small orange, and it not unfrequently extends so far along the bas-fond of the bladder that its summit cannot be reached by the finger in the rectum. Its structure is usually not changed, although in the progress of its growth the fibrous or the glandular elements may be found in some measure predominating. Sir Henry Thompson and others have observed, however, that in most cases of hypertrophy of this gland there exist, in the interior, minute isolated tumors. The glandular follicles are also occasionally enlarged and occupied by calculi, or by flattened polygonal or spheroidal epithelium in various conditions of desiccation or of dissolution. Polypoid outgrowths, resembling the fibroid tumors of the uterus, are found occasionally in connection with the enlarged prostate; and these are especially apt to form upon the middle lobe. The verumontanum is also liable to enlargement, independently of, or in connection with enlargement of the prostate, forming a pendulous polypoid projection, which may interfere with the passage of urine and with the introduction of instruments. Malignant tumors occur very rarely in connection with the prostate gland, and the few cases observed have been almost without exception encephaloid, and have occurred mostly in early life. The gland is subject sometimes to tubercular enlargement, or degeneration, in strumous persons.

Fig. 398.



Enlarged Middle Lobe of Prostate Gland.

The **diagnosis** of simple hypertrophy will be easily made by a consideration of the age of the patient, since it is seldom observed in persons under fifty-five years; by the slow and dribbling manner in which the urine escapes, and especially by the fact that it is not projected with force; by careful catheterism, and by exploration with the finger through the rectum.

Treatment.—The treatment of chronic hypertrophy is only palliative, and must be conducted with reference solely to the symptoms as they arise. The patient must be especially enjoined not to hold his water too long, lest thereby the atony of the bladder should be increased, and complete retention result; and if considerable urine is retained after each effort at evacuation, it should be drawn regularly by the catheter. Patients are often much comforted by taking daily fifteen or twenty drops of the balsam of copaiba, or five or ten drops of the spirits of turpentine. If the urine is alkaline or neutral, dilute nitric acid may prove useful; and if acid, alkalies may be given freely. The warm bath, conium, and morphine, are sometimes useful in relieving the constant desire to urinate caused by the retention and decomposition of the urine.

Prostatitis. Syn., Inflammatio Prostatæ, R. C.

Both acute and chronic inflammation of the prostate gland may occur at any period of life as a consequence of urethritis, or of direct violence. It is most frequently one of the sequences of acute and prolonged gonorrhœa. In rare instances, when the general health is previously much impaired, it occurs as an idiopathic affection.

In the acute form of the malady there is pain in the region of the gland, a frequent desire to urinate, accompanied often with a straining and tenesmus at stool; urination is painful, and sometimes completely interrupted either by spasm or by the obstruction offered by the swollen gland; there is generally some swelling and tenderness in the perineum, and on introducing the finger into the rectum the gland can be felt swollen, hot, and tender. When suppuration ensues an obscure fluctuation may generally be detected by rectal examination; and there are present also the usual signs which indicate the formation of matter in the deeper tissues of the body, such as rigors and febrile disturbance. When left to itself the pus generally discharges into the neck of the bladder, sometimes into the rectum, or upon the tegumentary surface in the perineum.

Treatment.--Whatever measures are known to allay vesical and urethral irritation are appropriate in these cases; and especially have we found full doses of morphine to afford relief. Very small quantities of cool water conveyed gently into the rectum are also serviceable. If pus has formed and fluctuation can be detected by rectal examination, the abscess should be opened with a small curved trocar from this direction; and if the pus points toward the perineum, it must be promptly evacuated by free incision. It seems proper to add, that if it becomes necessary to use the catheter, the utmost delicacy must be employed in its introduction; observing carefully all those directions heretofore given for the introduction of instruments in cases of simple hypertrophy of the gland.

Atrophy of the Prostate Gland.

This may exist as a congenital defect, or it may be the result of the pressure of calculi or of tumors, or of over-distention of the bladder in consequence of the presence of strictures. It is occasionally met with in old age when no appreciable cause can be found except senility.

Prostatorrhœa.

This affection, which has frequently been confounded with spermatorrhœa, consists in an abnormal glandular action on the part of the prostate gland, in consequence of which it discharges a larger amount than natural of clear glairy mucus, and a few drops may be seen to escape from the urethra after each urination or defecation; or it will be found gluing the orifice of the urethra together in the morning. Its peculiar appearance, the circumstances under which it escapes, and the application of the microscope will determine its character conclusively.

Treatment.—The treatment consists in the removal of all local causes of excitement and irritation, and the improvement of the general health by air, exercise, good diet, and tonics.

Rupture of the Bladder.

The bladder may be ruptured by direct blows, as when a man receives a kick upon the belly or is traversed by the wheel of a loaded vehicle; or by indirect blows, as when he falls from a height upon his back or pelvis. Rupture seldom or never takes place, however, unless the bladder is nearly or quite full. The point at which the viscus gives way is, in most cases, above, and posteriorly, where it is enclosed by peritoneum, so that the urine escapes at once into the peritoneal cavity.

The symptoms which indicate this accident are: pain, with excessive prostration and incessant desire to urinate, with the escape of but little or no urine. Blood is rarely evacuated by the urethra in the efforts made by the patient, but sometimes a little is withdrawn by the catheter. According to Mr. Birkett, a record of fifty examples presented only three recoveries, and in two of these the extravasation of urine occurred into the pelvic connective tissue, and not into the cavity of the peritoneum.

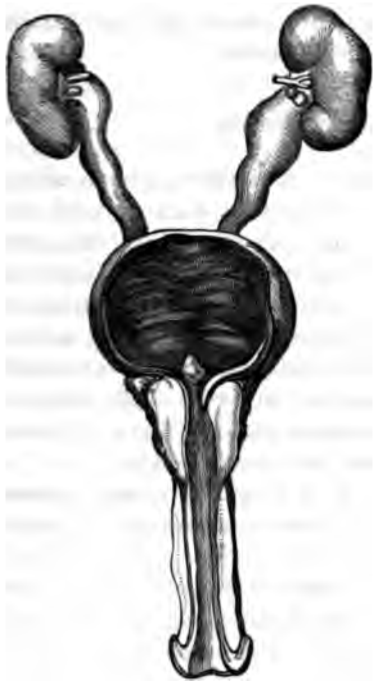
Treatment.—The treatment consists essentially in the use of opiates, and in the frequent and careful evacuation of the bladder by the catheter. When the diagnosis is fully made out, and the seat of the effusion can be determined, free incisions are demanded. If the rupture takes place below the peritoneal reflection, incisions as for lateral lithotomy, first practised by Walker, of Boston, may prove successful.

Hypertrophy of the Bladder. Syn., Hypertrophia Vesicæ, R. C.

As has already been stated, the long-continued existence of organic stricture, and of enlarged prostate, or serious urethral obstructions of any character, give rise, in many cases, to a thickening of the walls of the bladder. In these examples the hypertrophy seems to be due mainly, if not exclusively, to the inordinate action of the muscular fibres in their efforts to expel the urine. We have recently seen a case in which a gentleman died whose bladder was greatly enlarged and thickened, the interior presenting the usual fasciculated appearance, with dilatation of the ureters and expansion of the kidneys; but this patient had neither stricture nor enlarged prostate, but a transverse ridge or "bar," first described by Mr. Guthrie, composed of thickened fibrous and mucous tissue, situated just behind the verumontanum, afforded a palpable obstacle to the escape of urine as well as to the introduction of an instrument. His death occurred when he was about 50 years of age, but the difficulty in urination seemed to date from childhood, and, indeed, it was not rendered quite certain that it was not congenital.

The walls of the bladder are found, in these cases, from half an inch to one inch in thickness, the interior presenting a network of cord-like elevations, or of bands in high relief, resembling somewhat the columnæ carneæ of the apex and posterior wall of the left ventricle of the heart. The structure of the bands, and of the hypertrophied tissue in general, is found to be chiefly fibrous, with rather a diminished than increased amount of muscular tissue.

Fig. 399.



Hypertrophy of the Bladder, with Dilatation of Ureters and Kidneys, consequent upon Enlarged Prostate.

In a few rare cases the walls of the bladder gradually give way at some point, and the mucous membrane, with a portion of the fibro-muscular wall, is thrust out between the fibrous bands, forming a side pouch or supplementary bladder, which in some cases attains the size of the original bladder. These *sacculi*, as they are termed, may communicate with the bladder by small openings, and, having but few muscular fibres, their power of expelling their contents is very limited, so that they become permanent reservoirs of urine not only, but occasionally of calculi. Their solidity, and the fact that they are not even emptied by catheterism, has led frequently to the supposition that they were solid tumors. If, however, the bladder is first emptied, and then pressure is applied to the sac for several minutes in various positions of the body, they can in general be sufficiently emptied to establish a correct diagnosis.

It is scarcely necessary to say that, with the exception of the means to be employed to overcome the obstruction, the treatment, in all such cases, is expectant and palliative only.

Dilatation of the Bladder.

The same causes—namely, urethral obstructions—may, under apparently the same circumstances, produce opposite results. Such, for example, as dilatation, with thinning or atrophy of the walls. As in hypertrophy, the urine is in these cases also expelled with little or no projection, and the bladder occasionally becomes enormously distended without causing much inconvenience to the patient; but when the bladder is emptied by catheterism, in a case of hypertrophy, a hard, round ball remains, feeling like a fœtal head. In dilatation with atrophy or thinning of the walls, the bladder cannot be felt after evacuation.

Treatment.—The cause being removed, it will remain to give tone to the muscular fibres of the bladder by such remedies as nux vomica and ergot, and by improvement of the general health.

Cystitis, R. C.; Syn. Inflammatio Vesicæ.

Acute cystitis, of an idiopathic character, is not a very common affection; but it occurs pretty frequently in connection with gonorrhœal urethritis. The mucous membrane is in general alone involved, and especially that portion which is situated near the neck of the bladder. It is characterized by intense pain in the sur-pubic region, with tenderness on pressure, accompanied often with pain in the perineum, testes, and loins. The desire to urinate is almost constant; and the escape of the urine is attended with severe pain, smarting, and tenesmus. Rigors, with active febrile symptoms, are seldom if ever absent. The urine is at first scanty and high-colored, then reddish, being mingled with blood-corpuscles, and, finally, muco-purulent. It is a malady which reflects severely upon the general system, and often terminates fatally in from seven to fourteen days.

Treatment.—Absolute rest, hot baths, and hot fomentations to the belly and perineum, a single cathartic of blue mass, followed by tolerably full doses of morphia, barley water, and other cool diluent drinks, with the moderate use of alkalies, are the remedies which, in purely idiopathic cases, we have always seen prove successful. The same remedies are suitable in traumatic cases, but they do not so invariably accomplish a cure. When acute cystitis occurs as a consequence of gonorrhœa, the balsam of copaiba, buchu, and cubebs may be added to the above treatment, but they must not be given in large quantities.

Chronic Cystitis.—There are two forms of chronic cystitis. First, *simple chronic cystitis*, usually denominated the "irritable bladder," differing from the acute only in degree. This form is in a great measure amenable to the same plan of treatment which has been recommended for acute cystitis, only that it must be less energetic, and needs to be prolonged for a greater period of time. Second, *catarrhal cystitis*, a sequence of acute, or of simple chronic cystitis, and occasionally presenting its distinctive features from the commencement of the attack, characterized especially by the abundant secretion of mucus, and which is usually more or less mingled with pus. It is analogous to the catarrhal affection of the urethra, termed gleet, consisting essentially in passive hyperæmia of the tissues, accompanied with atony, especially of the capillaries. The mucus and pus will be seen mingled with the urine, or deposited upon the bottom of the vessel as a semi-transparent tenacious mass, resembling the white of an egg.

Treatment of Catarrhal Cystitis.—Usually this will be found to be an extremely obstinate and persistent affection. The topical treatment consists mainly in the frequent ablution of the interior of the bladder by tepid water, or water of the temperature of 98° to 100° Fahrenheit, for the purpose of removing those deposits which, becoming entangled with the mucus, and more or less decomposed, serve to perpetuate the irritation. For this purpose, an ordinary full-sized flexible or silver catheter may be employed, to the outer end of which a gum-elastic bag, supplied with a stopcock, is adjusted. The water must be introduced gently, and in quantity rarely exceeding three ounces, and then be allowed to escape. I have thought it advisable to repeat this process twice or three times at a sitting, once daily. If the urine is offensive, carbolic acid, in the proportion of one grain to the quart of water, will cause no irritation, and in most cases it will effectually correct the fetor.

As to the employment of astringents and dilute caustics, such as the superacetate of lead, the sulphate of zinc, and the nitrate of silver, I must confess that they have not, in general, seemed to accomplish much good; but, if employed, they should be at first introduced very much diluted, as, for example, one grain of the superacetate of lead to half a pint of water, or one grain of nitrate of silver to the pint, the strength being increased at each injection until three grains of the former, and one grain of the latter, to the ounce of water are attained.

After simple lavements of the bladder, general treatment has been found the next most reliable means; indeed general treatment can never be properly omitted. The internal exhibition of such remedies as the balsam of copaiba, buchu, uva ursa, and cubebs, in quantities to produce a moderate effect upon the kidneys, and long continued, seldom fail to give relief; but more than all, the surgeon must rely upon measures calculated to improve the general health. Patients affected with this malady, and who have long been under treatment in the wards of a hospital, often improve rapidly when sent out in the open air.[1]

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[1] "The Saddle as a Remedy for Chronic Cystitis," etc. By the Author. Read before the N. Y. Academy of Medicine, May 20, 1880.

Incision of the bladder through the perineum in the male, and the vagina in the female, as a means of giving rest to the bladder, has been practised with a certain amount of success; but it is not entitled to consideration except in cases of extraordinary and persistent suffering.

Tumors of the Bladder.

Fibrous Tumors seldom occur in the bladder, and are most frequently met with in early life. They originate in the submucous areolar tissue, and, projecting the mucous membrane before them, occupy the interior of the cavity, usually having a somewhat narrowed pedicle, as in polypoid growths.

Treatment.—In males, the treatment can only be palliative; but in females, after sufficient dilatation of the urethra, they have been removed by the ligature; owing, however, to the danger of hæmorrhage, it will be more prudent to remove them by a vesico-vaginal incision.

Villous, Papilliform or **Vascular Growths,** occurring in connection with the mucous and submucous tissues of the bladder, may be single or multiple. They are soft, flocculent, vascular, bleeding easily when touched, and seldom attaining a greater size than a large marble.

The usual symptoms are, the admixture of blood with the urine, and occasionally of small portions of the abnormal growths, pain in the bladder, with a frequent desire to urinate. They are seldom sufficiently large or firm to be recognized by the sound.

Treatment.—Weak solutions of sulphate of zinc, superacetate of lead, and of other astringents, may be thrown into the bladder; while such internal remedies are employed as may improve the health, or repair the losses caused by the constant bleeding. In the case of females they may, in some cases, be removed by evulsion, by the écraseur, or by scissors, either through the dilated urethra, or through a vesico-vaginal incision.

Malignant Disease of the Bladder, either encephaloid or scirrhus, is more frequent than either of the other forms of intra-vesical growths. In some cases it originates in the vesical walls, and in others it is propagated by contiguity of structure from the prostate gland, the rectum, or the uterus.

From fibrous and villous growths they may be distinguished by the rapidity of their progress, by the sudden and uncontrollable hæmorrhages, by the occasional discharge of the débris of the malignant structure—the precise character of which may be, in some instances, determined by the microscope—and by exploration with the sound. In the advanced stages the adjacent iliac glands sometimes become enlarged, and the usual constitutional signs of the cancerous cachexy are usually present.

Treatment.—To assuage the pain of an incurable malady, and to render the passage to the grave easier, is all that surgery or medicine can do in these unfortunate cases.

Hæmaturia, R. C.

Hæmaturia is not properly a disease, but only a symptom. Blood may be present in the urine as a consequence of villous and malignant growths, of ulceration, or of traumatic lesion of the coats of the bladder; it may be derived from the kidneys, ureters, bladder, prostate gland, or urethra. When present in a small quantity, intimately mingled with the urine, it gives to this excretion a smoky tint; but when blood escapes in larger quantities, it may be in clotted masses, or it may give to the urine the appearance of unstrained coffee. The microscope will always determine whether the color is due to the admixture of blood-corpuscles; and not unfrequently, by the presence or absence of casts and of other débris, determine also their source.

URINARY DEPOSITS.

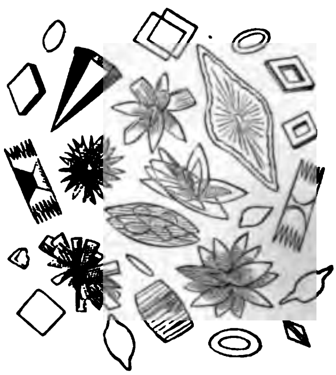
The urinary excretion is subject to great fluctuations, both in regard to quantity and quality, when the kidneys and the general system are in a condition of health. Thus, according to Dr. Austin Flint, Jr., assuming that the usual quantity of urine excreted in the adult male during twenty-four hours is about fifty fluid ounces, it may be stated in general terms that the range of normal variation is between thirty and sixty, and that only when the quantity varies considerably from these figures is a pathological condition to be inferred; and rating the ordinary specific gravity, when at 60° Fahr., as 1020, it may range as low as 1005 or as high as 1030, without implying a deviation from health. The reaction of the urine is usually acid at the moment of its discharge from the bladder; but at certain periods of the day it may be feebly alkaline or neutral. The urates, phosphates, and other salts are liable, also, to constant variation. Mucus and epithelium are always present in greater or less proportions, and constitute the principal part of the sediment in healthy urine; but, as already intimated, there are certain conditions of the general system in which the relative proportions of one or another of these elements greatly exceed these proportions in health, or in which entirely new elements are introduced. These conditions, when observed to be persistent, are termed "diatheses."

Three diatheses are usually described, namely, the uric acid (lithic), the oxalic, and the phosphatic, since in a large majority of cases calculi are composed of the urates, of the oxalates, or of the phosphates. In rare and exceptional cases calculi are composed of cystine, xanthine, or of the carbonate of lime. The concretions occasionally observed, called fibrinous calculi, uro-stealiths, and blood calculi, are pseudoform, and cannot be classified as true calculi.

When the urinary deposits are amorphous and impalpable they are termed "sediments;" when existing in the form of small crystals, or of small solid segregations, they are designated as "gravel," or "sand;" and when, by concretion or crystallization, they are built into solid masses of considerable size they are known as "calculi," or "stones." Urinary calculi forming in the pelvis of the kidney are denominated "renal;" in the bladder, "vesical."

Uric Acid Diathesis.—Uric acid deposits, in the form of a yellowish red, or lateritious crystalline sediment, are exceedingly common. These crystals may become aggregated in the form of sand or gravel; and finally, they may assume the structure and size of calculi.

Fig. 400.

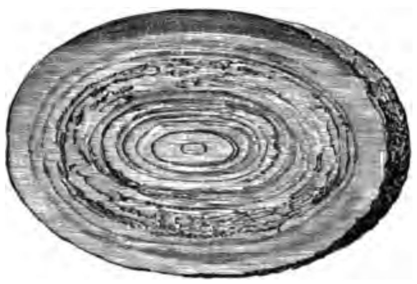


Uric Acid Crystals.

Uric acid calculi vary in size from a millet seed to a hen's egg. They are smooth, or only slightly roughened on the surface, of a light brown, reddish or mahogany color; and of a flattened oval form. On section they are found to be composed of concentric laminæ, presenting a variety of shades of color.

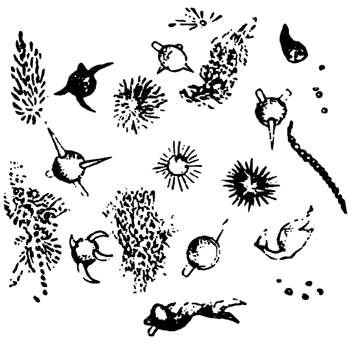
Sediments of the *urate of ammonia* are quite common, but completely formed calculi of this variety are rare. They seldom attain much size, and in form they resemble the uric acid calculi, but their color is generally characteristic, being in most cases much lighter than the latter, and of a pale fawn. In this regard, however, there is considerable variation. They are compact, seldom lamellated, brittle, and they break with a fine earthy fracture.

Fig. 401.



Uric Acid Calculus.

Fig. 402.



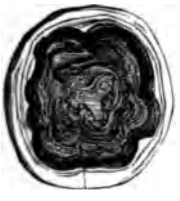
Urate of Ammonia Crystals.

The presence of uric acid in sediment, gravel, or a calculus, may be determined by treating a small portion of the substance with nitric acid and holding it over a spirit lamp until effervescence is completed and it is reduced to a dry powder. When the residue thus obtained is cool, the addition of a drop of ammonia will produce a bright violet color. By boiling in liquor potassæ, the uric acid calculus is completely dissolved. The urate of ammonia may be dissolved in the same manner, but, during the process, the presence of ammonia will be detected by the odor.

Uric acid deposits are observed most frequently in the urine of persons suffering from gout or rheumatism, or from some chronic cutaneous eruption. Sediments of the urate of ammonia are most common in children who are imperfectly nourished, or who possess strumous constitutions.

Oxalic Acid Diathesis.—The oxalate of lime, or mulberry calculus, has in most cases an irregular tuberculated angular or spinous form; its color is usually a dark brown, and it is seldom larger than one inch in diameter. Occasionally it is presented in the form of small, white, smooth concretions, resembling hemp-seed; and a rare variety has been described as of a milk-white color. The natural and characteristic form of the calculus may also be concealed by phosphatic incrustations. The urine is generally pale and abundant, and furnishes no visible sediment, but the crystals may be found suspended in the fluid, by microscopical examination.

Fig. 404.

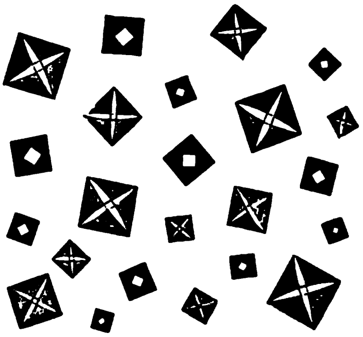


Section of a Mulberry Calculus, incrusted with Phosphates.

The oxalic acid diathesis has been observed especially in persons whose nervous systems have been exhausted by excessive mental activity, or by venereal indulgence, and whose digestive and assimilative functions are at the same time impaired.

The oxalate of lime is soluble in hydrochloric and in nitric acid, but insoluble in liquor potassæ. If fused under a blowpipe in a platinum spoon, a white ash of caustic lime remains, which, if thrown upon moist, reddened litmus paper, changes the color to an intense blue.

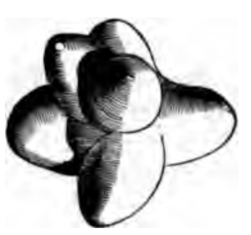
Fig. 403.



Oxalate of Lime Crystals.

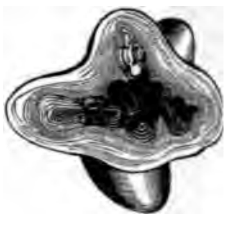
Phosphatic Diathesis.—The *mixed* (fusible) *phosphates*, composed of the phosphate of lime and the ammonio-magnesian phosphates, frequently incrust calculi formed of the urates or of the oxalates, or which have as their nucleus some foreign body introduced into the bladder; but in other cases the entire mass is phosphatic. They may attain a great size. Sometimes they are globular or ovoid in form, and at other times they assume a variety of irregular forms, being apparently shaped to the irregularities of the surface upon which they have reposed. Their color is white, gray, or yellowish. They are quite friable, breaking down under the fingers like chalk, and are often composed of concentric laminæ, which easily separate, but in other cases the laminæ are wanting. They are very soluble in acids, but insoluble in alkalies. Under the intense heat of the blowpipe they fuse into a hard enamel.

Fig. 405.



Renal Calculus.

Fig. 406.

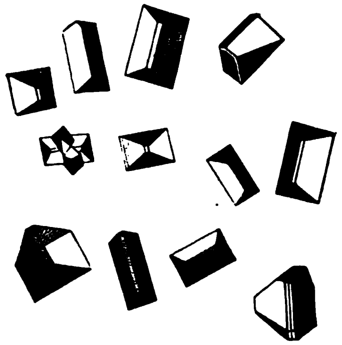


Section of the same.

More rarely we meet with one or the other of the salts which compose the mixed phosphates, alone. The *phosphate of lime calculus*, of renal origin, is, according to Wollaston, composed in a good measure of animal matter; it is of a pale brown color, smooth, lamellated, but the lamellæ are easily separated; while the vesical calculus of the same name is composed of the phosphate of lime in a condition similar to that found in bones. Hence it has been called the "bone earth" calculus.

The *ammonio-magnesian phosphatic calculi*, known also as the *triple phosphates*, are usually white, presenting upon the surface, when recently removed, minute brilliant crystals. Some are hard and crystalline, in fracture; others are friable and imperfectly lamellar.

Fig. 407.



Triple, or Ammonio-Magnesian Phosphatic Crystals.

The phosphatic diathesis is usually found in old persons with broken constitutions.

There are other forms of calculi which are occasionally met with, which indicate, probably, peculiar constitutional diatheses; but the infrequency of their occurrence, and the little that is known of their relations to the general conditions of the system, will not justify us in speaking of them at much length.

The **uric oxide** calculus, known also as the **xanthic oxide,** or **xanthine,** was discovered by Dr. Marcet in 1815. We have found but one or two other recorded examples.

The **cystic oxide,** or **cystine calculus,** is also exceedingly rare. The name would imply that it is found originally in the bladder, but the fact seems to be that it is a production of the kidneys. Its distinguishing characteristic is, that it contains a considerable proportion of sulphur; the presence of which gives to the calculus a peculiar yellowish, greenish, or waxy appearance.

Calculi of the **carbonate of lime** were first observed by Bruquatelli in 1819. It has been doubted whether they are even true urinary deposits, the majority of specimens having been found within the prostate gland; but Bruquatelli has found them in the bladder of a woman.

According to Dr. Bird, the so-called **fibrinous calculus** is only inspissated albumen, the product of diseased or irritated kidneys.

The **uro-stealith** is also one of the pseudo-forms. It is not properly a calculus, but whether it is a resin or a fat is not yet determined.

Dr. Alison found in the kidneys of a man who died of consumption, small black concretions, which he believed to be composed chiefly of **blood-corpuscles.**

VESICAL CALCULI.

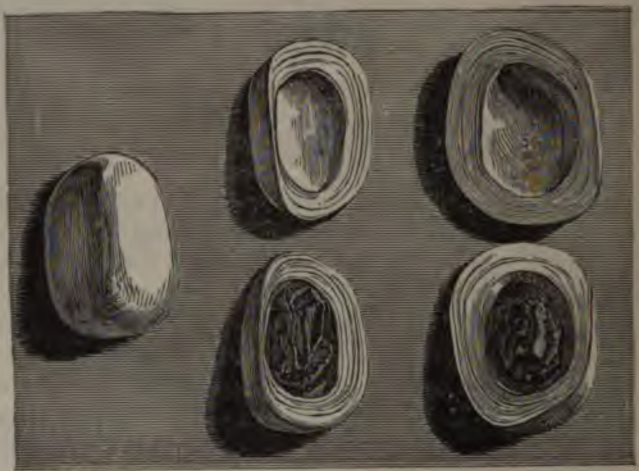
Stone in the bladder is much more frequent in certain localities than in others. In the United States, it is most common in Kentucky, Ohio, Tennessee, and Virginia. In the New England States it is exceedingly rare. The same inequality of distribution as regards locality has been noticed in other parts of the world. It is probable that climatic and other influences determine, in some measure, these topographical differences; but it is well known that vesical calculi are met with most frequently in lime districts, and especially where the lime rock is soft and soluble, and the water constantly holds a large amount in solution, as is the case in the States of Kentucky and Tennessee. Of the climatic influences, the most active are moist and changeable temperatures.

It is reasonable to suppose that food, drinks, and occupations, or general habits of body, so far as they affect digestion and assimilation, may influence the formation of stone; but there are no reliable statistics which establish this supposition. As has already been stated, gout, rheumatism, dyspepsia, nervous exhaustion, scrofula, etc., are often associated with particular diatheses, as indicated by peculiar urinary deposits; and it is probable that they influence in a like manner the formation of calculi.

Calculi are much more common in men than in women, owing no doubt to the fact that the female urethra is shorter and more capacious, and the vesical concretions are therefore less apt to be retained. They are said to be more frequently met with among the poor and the laboring classes than among the rich. Sailors, however, are believed to be remarkably exempt. Gross affirms that stone in the bladder is three times more frequent in certain Southern States among negroes than among the whites; and, according to the same author, an analysis of 6,042 cases has shown that more cases occur prior to, than after the twentieth year of life.

Whatever causes a detention of the urine in the bladder, as for example paralysis of its muscular coats, hypertrophy accompanied with the formation of sacculi, enlargement of the prostate, and stricture, may give rise to calculous concretions; catarrhal cystitis favors the entanglement and retention of urinary deposits; and finally, the presence in the bladder of foreign substances of any kind, such as blood, fragments of bone, or balls left from gunshot accidents, various substances conveyed into the bladder accidentally or intentionally through the urethra.

Fig. 408.



Mackenzie's case of Five Phosphatic Calculi, of which the Nuclei were Beans.

Very many vesical calculi originate in the kidneys or in the ureters, owing to diseased conditions, or obstructions in these organs; and escaping from thence into the bladder, while they are yet small, subsequently attain a more considerable magnitude.

The size of calculi varies from a pin's head to several inches in diameter. We have removed from the female bladder, but not until after having broken it into several fragments, a phosphatic calculus weighing four ounces and some grains; and from a male the largest calculus we have removed weighed also a little over four ounces, being two inches and seven-eighths in its longest, and two inches in its central transverse diameter. In many cases, however, the calculi have much exceeded these limits both in size and weight. Mr. Erichsen says he saw in the possession of Uytterhooven, of Brussels, a calculus removed by him, by the high operation, 6½ inches long by four in width at its widest part. Mr. Cline attempted, but failed to extract a calculus of about the same size, weighing 44 ounces. Morand saw a calculus weighing 6 pounds. The majority of calculi, when removed, are from one to two inches in diameter, and weigh usually from one to two ounces;

the largest being generally composed in part or in whole of the phosphates. The oxalates are usually the hardest; but the urates are often quite hard, although more brittle; while the phosphates are comparatively soft and friable.

There is usually but one calculus in the bladder at a time, but the number may vary from one to a thousand. The only instance, however, in which this extraordinary number has been found, was in the person of Judge Marshall, operated upon by Dr. Physick, of Philadelphia. In this case, the calculi varied in size from a partridge-shot to a bean. When two or more calculi exist in the bladder their opposing surfaces usually acquire a polish by attrition, and present facets which indicate where they lay in contact. A single calculus may become fissured, and ultimately separate into two or more within the bladder; and finally, calculi originally separate, or separated by fissure, may agglomerate into one single but irregular mass.

Calculi generally occupy the most depending portion of the bladder, lying unrestrained in the cavity, and falling in whatever direction the force of gravity may tend to carry them; but in some cases they become entangled in the granulations which spring from ulcerated points of the bladder, or they are lodged in the vesical orifices of the ureters, or in cysts of the prostate gland, or in sacs formed from the walls of the bladder. By a species of hour-glass contraction of the bladder, also, they may be imprisoned in the fundus. Portions or the whole of the interior of the bladder may be incrusted with phosphatic deposits.

Symptoms of Stone in the Bladder.

In rare examples the patient has suffered certain premonitory symptoms which sufficiently indicate that he has a stone in his bladder. Renal calculi have from time to time passed from the kidneys into the bladder, the passage being accompanied by peculiar and distinctive pains; and each time, after more or less delay, the calculus has escaped by the urethra. On the last occasion, however, the calculus has been detained after reaching the bladder; and although other evidences may be wanting, this alone is sufficient to determine its presence.

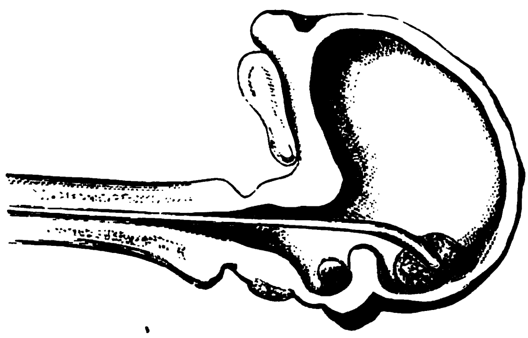
The ordinary subjective signs are as follows:—Pain at the neck of the bladder, or at some point in the hypogastric or perineal region, aggravated by riding in a rough wagon, or by anything which jars or rudely concusses the pelvic viscera. The pain is especially acute immediately after urination, when the bladder contracts and crowds the calculus toward its neck; even the vesical contractions which precede urination are generally quite painful. In the male, usually, there is at the same moment a sharp, lancinating pain in the glans penis; or this pain may exist when the vesical pains are absent. In the case of male infants, the first suspicion on the part of the surgeon originates from the fact that the little sufferer pinches and pulls at his prepuce constantly, and especially after and during urination, or his prepuce is observed to be much elongated, as a consequence of this practice. Sympathetic pains are also sometimes experienced in the scrotum, testes, along the thighs, in the loins, or in other and remote parts of the body. A catarrhal inflammation of the mucous membrane of the bladder sooner or later ensues, accompanied with a frequent desire to urinate, and the passage of mucus with the urine, occasionally streaked with blood, or mingled with pus. The escape of urine is sometimes suddenly arrested by the lodgment of the calculus against the neck of the bladder, when, by a change of position, the urine will again flow freely; or it may be arrested by a spasm of the involuntary sphincter muscles, and after a moment's delay, although the position is not changed, it will flow again freely. The rectum often participates in the irritation and spasm, and this is especially apt to be the case with children.

No one of these several symptoms, and indeed not all of them associated, ought ever to be accepted as conclusive evidences of the existence of a stone, since, with the single exception of the premonitory symptom of the passage of a renal calculus to the bladder, and its subsequent detention, all of them may be imitated by other diseases, such as neuralgia, spasm, or inflammation of the bladder.

Exploration with the sound or catheter can alone render it absolutely certain that a calculus is the cause of the symptoms described. The sound is always preferred in a physical exploration of the bladder, for the reason that, being solid, it conveys more accurate and distinct sensations to the fingers and the ear. The age and sex of the patient will generally determine the size and form of the instrument to be employed. In some cases the existence of stricture, or of an enlarged prostate, or of vesical pouches, will control the choice. In general, with adults, a rather large or medium-sized instrument, with a straight shaft, and curved to an angle of 45° or less at its vesical extremity, is to be preferred.

The instrument should first be introduced before the water has been evacuated; or, if the patient is unable to hold his water, it will be advisable to follow the practice of Civiale, and inject a moderate quantity of tepid water previous to sounding. We prefer to make our first exploration when the patient is not under the influence of an anæsthetic, in order that the sensibility of the bladder and urethra may be ascertained. He should repose upon his back, with the shoulders slightly elevated, and his legs drawn up, as for catheterism. When the beak of the instrument has fairly entered the bladder, it should be gently advanced and withdrawn, or one quarter rotated to each side; or finally, in case the calculus is not yet detected, it may be half rotated, so that the beak shall present toward the bas-fond. A finger in the rectum of the male, or in the vagina of the female, or the hand over the pubes, will sometimes aid in bringing the stone into contact with the instrument, if it is not actually felt by the finger. Failing in these manœuvres, the patient may be turned upon his side, or directed to stand, while the exploration is repeated; or he may incline very much forwards; or, finally, if the bladder is not already evacuated, the instrument may be withdrawn, and the exploration repeated carefully while the bladder is empty. A hollow sound, through which water may be injected without removal, is sometimes advantageously substituted for the ordinary sound.

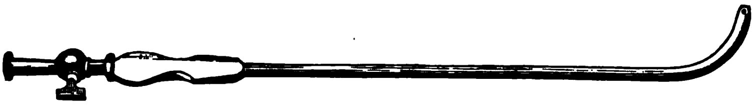
Fig. 409.



Exploring the Bas-fond.

If the stone has not been felt, and a suspicion still remains that it is present, the patient should be permitted to rest a few days, and then the examination should be repeated while he is under the influence of an anæsthetic. It is possible that, owing to the position of the stone, or to other circumstances not always fully explained, the calculus cannot be felt at one time, but may be easily detected at another, or the surgeon may fail altogether to recognize its presence. On the other hand, even slight phosphatic concretions upon the surface of the bladder, especially in the prostatic portion, may induce a belief that the patient has a calculus. This error will be avoided generally by observing that the roughened bladder conveys through the instrument only a sensation of grating, and never a distinct click.

Fig. 410.



Hollow Steel Sound.

General or Constitutional Treatment.

By the employment of certain mineral acids and alkalies internally we may in very many cases effect a modification or an entire change in the reaction of the urine. In the same manner also, but less constantly, the character of the urinary deposits may be altered, or their amount sensibly diminished. It is proper to assume, therefore, that the formation of urinary calculi may by these means be occasionally prevented, or their growth delayed; but that chemical reagents, however judiciously selected, have the power of dissolving stones in the bladder is by no means established to the satisfaction of most surgeons. This pretence has been set up from time to time, in favor of their nostrums, by a multitude of empirics, and even by a few intelligent practical surgeons; but they have all hitherto failed to furnish us with that kind of testimony in support of their theories which science demands. Thus, for example, it is affirmed of the waters of Vichy, which contain a large amount of the bicarbonate of soda, and are highly charged with carbonic acid, that their free and continued use will cure stone in the bladder; the soda reducing the urates and the free carbonic acid the phosphates; the latter acting also by its property of dissolving animal matter, and thus destroying, in some measure, its power of cohesion. That the character and amount of certain urinary deposits, under the influence of these waters, may be changed, and the condition of the bladder itself greatly improved, is quite probable, but this is the limit of their legitimate claims. The bicarbonate of soda or of potassa may be given with marked benefit, especially in the case of uric acid calculi; but it must not be forgotten, also, that their long use may seriously impair the organs of digestion, and thus accomplish quite as much harm as they are capable of doing good.

To the same extent, also, and with much more certainty, the patient suffering with a calculus may obtain relief by general hygienic and therapeutic measures. He must avoid all known and special causes of vesical irritation, such as riding on horseback, or in a wagon, over rough roads, exposure to the cold, and all sudden vicissitudes of weather, the free use of acid fruits, of wines, or ales. In general, all alcoholic stimulants should be forbidden, or, if any are used, gin should be preferred; but we do not believe that any alcoholic drinks can ever be said to be useful, except as they may occasionally be found to be serviceable when used in small quantities, in improving the tone of the digestive organs. It will be advisable, also, to instruct the patient not to drink water which contains lime.

Treatment by the Injection of Solvents into the Bladder.

Mr. Brodie thought he had dissolved and brought away certain soft, phosphatic calculi by the injection of very weak solutions of nitric acid, of the strength sometimes employed in chronic cystitis—two or three drops to the ounce of water; and hydrochloric acid has been suggested for the same class of cases; dilute alkalies have been recommended for uric acid calculi; also, in certain cases, the salts of lead, and a variety of other reagents. Water has been permitted to irrigate the bladder through a double canula for half an hour at a time, every two or three days; but, up to this time, the results obtained by these various reagents and lavements are admitted to have been, in most instances, so partial and occasional as to give little ground for encouragement.

Treatment by Electrolysis.

A few years ago some hope was entertained that the electrical current might be made applicable to the solution of the stone within the bladder; and various ingenious forms of apparatus were contrived for its employment. In 1856 Mr. Bence Jones informed Mr. Druitt that he thought he was about to succeed. By the aid of a powerful galvanic battery, employing a solution of the nitrate of potassa, he was able to dissolve phosphatic calculi at the rate of twenty-five grains per hour. Oxalate of lime and uric acid calculi were acted upon much more slowly. The problem which remained was, how to insulate the voltaic current and protect the bladder and urethra from its action. This he believed he had accomplished by the use of vulcanized rubber as an insulator. Here, however, the record of his experience ends. It would seem, therefore, that the experiment failed There is a statement somewhere that a Dr. Melicher, a German physician, succeeded in two cases in dissolving a stone in the bladder, as long ago as 1848, by electrolysis; but no verification of the statement has been published, and it is probably not true.

Treatment by Dilatation of the Urethra.

The removal of calculi from the female bladder, by dilatation, has
long been practised; and the several methods employed will be partic-
larly described when the subject of calculus in the female bladder is
der consideration. But the removal of a calculus from the male
dder, by dilatation and the forceps alone, is altogether another thing,
is very seldom attempted. The male urethra is long, and capable
ly a moderate amount of dilatation; and laceration of its walls by
d dilatation and extraction is a much more serious matter than a
r injury to the female urethra.

en, however, patients have been in the habit of passing small cal-
r it is known that a renal calculus has dropped into the bladder,
detained, or other sufficient evidence exists that a calculus of
te size cannot be passed by the efforts of the patient alone, and
no condition of the urethra or of the prostate to forbid, it will
er to dilate the urethra gradually by the introduction of sounds,
encourage the patient to attempt to get rid of it, by holding his
until the bladder is full, and then forcing it out with some
or he may stop the stream by grasping the penis while the urine
ng, and then let it escape suddenly. The free use of diuretics,
increasing the amount of urine in the bladder, will sometimes
e manœuvres.

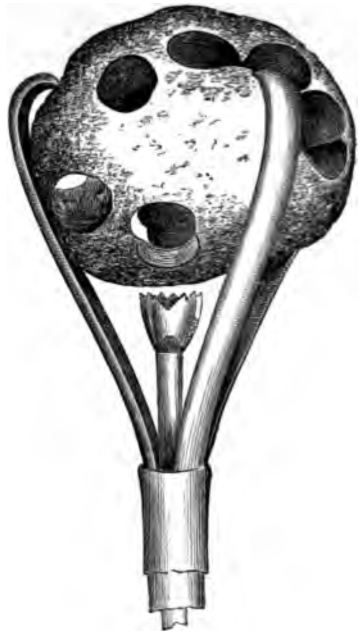
If the calculus becomes lodged in the *urethra*, and especially if its situation can be determined by touch, it will then always be proper, after suitable attempts have been made to force it out by straining, or by pushing upon the calculus, to attempt its extraction by forceps. For this purpose we have employed successfully our own narrow bullet forceps, and, in other cases, a long, narrow pair of dressing forceps; but surgeons have invented forceps especially for the extraction of urethral calculi, and, if the stone is in the sub-pubic portion of the canal, such instruments will be required. We shall refer to this subject again.

Lithotripsy. Syn., Lithotripsis, R. C.

Properly speaking, lithotrity is the operation of grinding the stone in the bladder, and lithotripsy is the operation of breaking or crushing the stone; but very many writers have omitted to observe this distinction, and have included under the terms lithotrity or lithotripsy, indifferently, all methods which reduce the stone to small fragments. We shall endeavor to preserve the original and proper distinction between these terms.

Although lithotripsy and lithotrity have been practised from a very early period, yet the instruments were either so rude, or the operators in general so inexpert, that neither of these methods was able to secure the confidence of surgeons, until, in 1824, Civiale invented and applied successfully his lithotrite, an instrument for grinding the stone in the bladder. For several years Civiale's instrument, exceedingly ingenious, but cumbrous and complicated, found no successful rival in public favor. In his own hands especially its achievements became remarkable, and secured for him and for the operation of lithotrity a permanent reputation. It was not long, however, before, attracted by the brilliancy of his success, a large number of surgeons entered the field with new or very much modified instruments; many of which proved so much superior to that employed by Civiale, that they were soon substituted for his instrument, and, indeed, Civiale himself acknowledged their superiority by adopting in the place of his original straight lithotrite, a curved lithotriptor, intended for breaking and crushing the stone. The curved

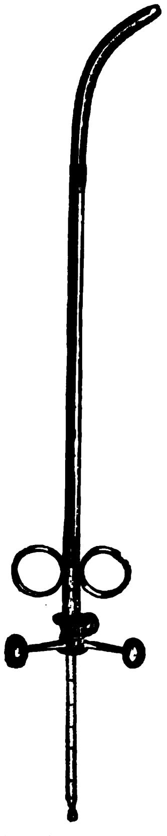
Fig. 411.



Section of Civiale's original Lithotrite, grasping a Calculus.

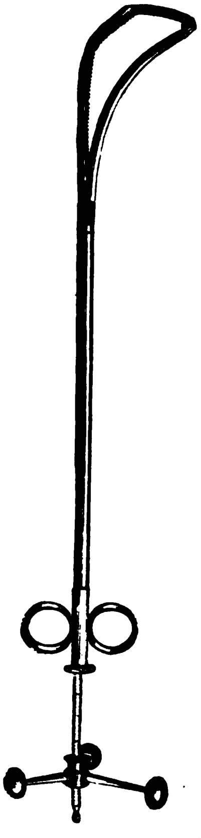
instruments invented by Jacobsen, Weiss, and Heurteleup, served as the basis upon which the later and improved instruments were constructed; and at the present time lithotripsy is almost universally substituted for lithotrity, although the form and mechanism of the instruments have undergone many changes in the hands of Civiale, Leroy d'Etoilles, Charrière, Fergusson, Thompson, Bigelow, and others.

Fig. 412.



Weiss' original Lithotriptor.

Fig. 413.



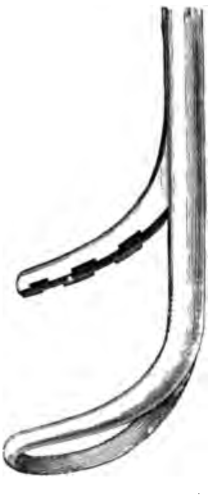
Jacobsen's "Lithotrite" (Lithotriptor).

Conditions which may determine a preference for Lithotomy or Lithotripsy.—Without attempting to consider the relative fatality of the two operations—which have indeed been estimated very differently by different writers, and which must depend, we suspect, upon a proper selection of cases for the two methods—it may be stated in general: 1, that lithotripsy is most easy of execution and most successful in women; 2, in adult males, especially in those of middle life, whose urethræ and bladders are in a tolerably healthy condition; 3, in cases where the stone is small, phosphatic, or brittle; or, if we speak with reference to age alone, it may be said that lithotripsy is to be reserved especially for those examples of stone in which the age of the patient is over fifteen or seventeen years. While, on the other hand, lithotripsy is peculiarly difficult, and sometimes wholly inapplicable: 1, when the urethra is strictured or exquisitely irritable; 2, when the bladder is very irritable, inflamed, ulcerated, contracted, hypertrophied, or sacculated, or when it is in a condition of extreme atony; 3, when the prostate is much enlarged, as so often is found to be the case in old age; 4, when a pretty large stone is associated with a narrow but healthy urethra, a condition which sometimes obtains in childhood and infancy; 5, when the stone is of very great size, or very hard, or encysted; 6, when there are a large number of calculi; 7, when the kidneys are suffering from serious organic disease, or the general health is greatly impaired.

In infancy and childhood lithotomy is easy of execution, and its results are seldom fatal. Moreover, when the prostate is enlarged, whether from advancing years, or from any other cause, its section, by the operation of lithotomy, is rather salutary than otherwise; and I do not think, in such cases, at least when the hypertrophy of this gland is considerable, lithotripsy ought ever to have the preference, notwithstanding that some excellent surgeons do not hesitate to perform this operation under these circumstances.

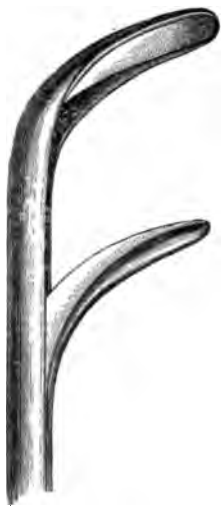
The Instruments required in Lithotripsy, as now practised, are a steel sound—constructed with a shorter beak and having a more abrupt curve than the ordinary silver male catheter—to be employed in exploring the bladder and in determining the position of the stone. Sir H. Thompson prefers for this purpose a steel sound, perforated like a catheter, which permits the gradual escape of the urine, and the shaft of which is graduated and furnished with a slide, to determine approximately the size of the stone. There will be needed, also, a catheter for the purpose of injecting the bladder with fluid prior to the operation, in case the patient is unable to hold his urine; a syringe, capable of being adjusted to the catheter, or hollow sound; and two lithotriptors — one with the female blade fenestrated, to be used in breaking the stone, and with which alone the operation can be, in many cases, completed; the second, a plain bladed instrument (Civiale's lithoclast), for the

Fig. 414.



Lithotriptor with Fenestrated Blades.

Fig. 415.

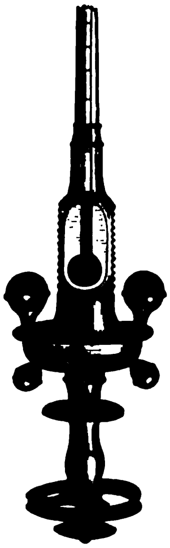


Civiale's Lithoclast.

rpose of pulverizing the fragments in case the fenestrated instrument ls to do this sufficiently. The male or movable blade of the latter uld be narrower than the fenestra of the female blade, to facilitate displacement of the detritus from between their opposing sur:es.

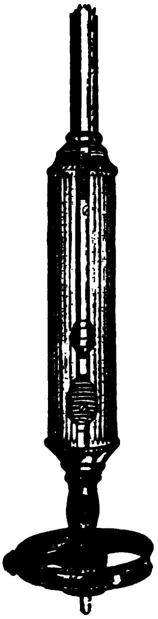
Among the various lithotriptors constructed, the choice will depend y much upon the fancy or experience of the surgeon. The opera-n of lithotripsy is almost purely mechanical, and when the surgeon become practised in the use of one instrument, although it may be others maladroit, he cannot safely substitute it by even one which is some respects more perfect. There are two which are at present st in use, namely, Charrière's and Weiss', known also as the French d English instruments, between which the essential differences are und in the construction of the handles, and in the management of *écrou brisé*, originally devised by Charrière. The handle of the glish instrument is cylindrical and grooved, rendering it more venient for the hand; and the adjustment or fixation of the male ft is effected by means of a slide, seen on the face of the handle,

Fig. 416.



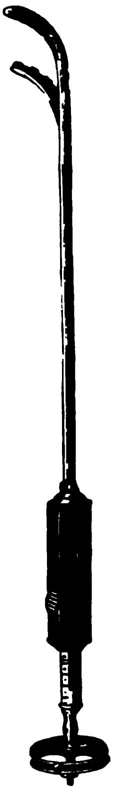
Handle of French Instrument.

Fig. 417.



Handle of English Instrument (Weiss and Thompson's).

Fig. 418.



English Instrument Complete.

rather than by the movable, button-like disk attached to the extremity of the French instrument.

Preparation for the Operation in the Male.—It is desirable, as far as practicable, to allay all excessive irritability of the bladder by confinement to bed for a few days prior to the operation, and by the use of simple diet with demulcents. During this period also a sound should be introduced every day or every second or third day, the size of which should be gradually increased until, in the case of an adult, the capacity of the urethra is found to be sufficient for the easy passage of No. 15 or 16 of the English catheter scale. When the hollow sound is employed, the urine may be withdrawn as often as the instrument is introduced, and from four to six ounces of tepid slippery-elm water thrown into the bladder; or the same may be done occasionally with a common catheter.

Two days preceding the first operation the bowels should be evacuated by a mild aperient, and on the morning of the day of the operation the rectum should be emptied by an enema of tepid water. Opiates, which render the urinary secretions scanty and acrid, ought never to be employed unless the necessity for their use is urgent. During an hour or more immediately preceding the operation, the patient should lie in bed with the hips a little elevated in order to remove the calculus from the more sensitive portions of the bladder.

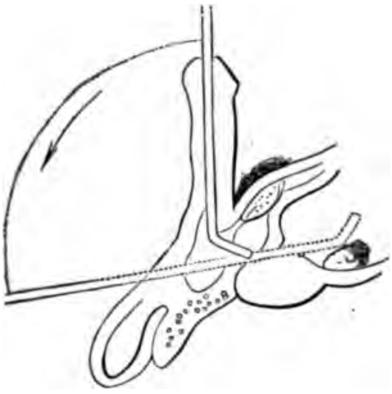
If the patient is able to retain his water until five or six ounces have accumulated, no injections into the bladder will be required; but if he is not able to do so, a few ounces of tepid water should be injected through the catheter before the lithotriptor is introduced.

If the bladder or the urethra has been discovered to be very sensitive and intolerant of the presence of the sound or catheter, or if the patient labors under excessive apprehensions, it may be proper to place him under the influence of an anæsthetic; but if these conditions do not exist, it will be better not to render the patient insensible, since his sensations will often prove a useful guide to the surgeon in determining whether the instrument is pressing unduly upon the neck of the bladder, or has engaged the mucous membrane in its grasp.

Operation of Lithotripsy by Civiale and Thompson's Method.

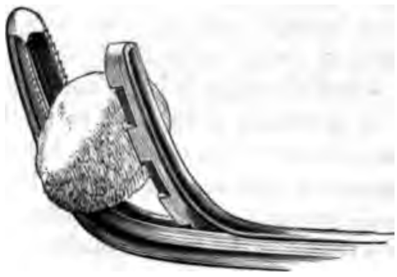
The patient resting upon his back, with his hips slightly elevated, the lithotriptor, previously warmed and oiled, is introduced closed, in the same manner as if a sound, having the same curve and length of beak, was employed. It is probable that the stone will be touched, and its situation recognized as the beak of the instrument enters, and traverses the floor of the bladder; ordinarily it will be found lying some distance removed from the neck, at the base of the trigone. The beak of the lithotriptor should then be slightly elevated and advanced to near the centre of the bladder; when the male blade is slowly withdrawn an inch or more, and the instrument turned upon its axis to the right about 45°, and closed. If in this manœuvre the stone has not been felt, the instrument is brought to its original position, opened and turned upon its axis to the left. In case the stone is not yet discovered, the operator will depress the handle of his instrument so as to slightly elevate the beak, and repeat the manœuvre above described, making the beak incline horizontally to the right and to the left.

Fig. 419.



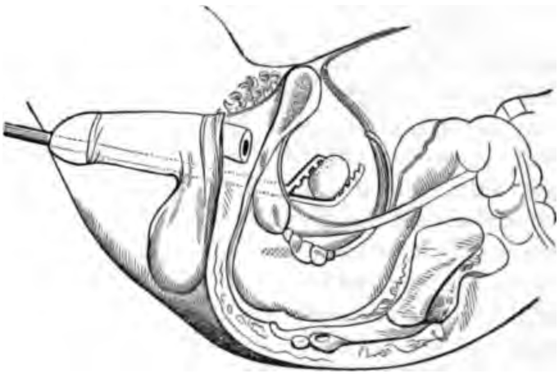
Introduction of the Lithotriptor.

Fig. 420.



Calculus seized and ready for crushing.

Fig. 421.



Position of Lithotriptor in Crushing the Stone.

Finally, if necessary, the same manœuvre will be repeated the third time, only that now the beak will be turned, when opened, directly backwards toward the posterior wall of the bladder. The stone will generally be felt and seized by either the first or second position of the instrument, and it is only when the third lobe of the prostate is enlarged, or we are searching for small fragments after the stone has been crushed, that it will be required to place the instrument in the third position. The lithoclast is only to be employed when, in the last stages of the operation, it is desired to pulverize completely all the remaining fragments.

This method, recommended by Civiale and adopted by Sir Henry Thompson, causes the least possible irritation, since the area of operation is at or beyond the centre of the bladder, the coats of which are not necessarily at any moment brought into contact with the instrument; and if the shaft of the lithotriptor is held firmly, and never allowed to move except upon its own axis, the vesical portion of the urethra, which is always exceedingly sensitive, is never disturbed.

When the stone is large and is lodged near the neck of the bladder, as it generally is in such cases, the procedure is varied by arresting the instrument the moment it has fairly entered the bladder; and now, instead of opening the forceps by withdrawing the male blade, which would cause it to press upon the neck of the bladder, this must be done by advancing the female blade.

Baron Heurteleup's Method. *(Adopted also by Mr. Guthrie, Cæsar Hawkins, and others.)*

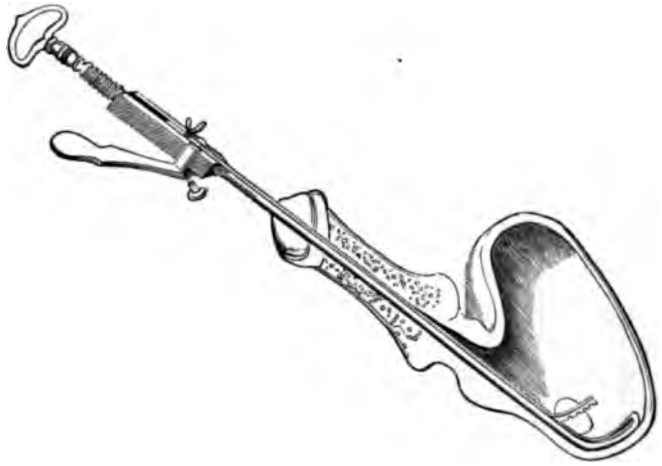
The lithotriptor being introduced, the handle is elevated so as to bring the convex surface of the beak in contact with the posterior wall of the bladder; the male blade is then withdrawn, while the female blade, remaining fixed in its position, is pressed gently against the posterior wall. In this way that portion of the bladder against which the convex surface of the female blade rests is depressed below the level of the adjacent portions, and the stone falls into the grasp of the open instrument; when it is seized, elevated slightly, and crushed. If it is not thus made to fall between the blades, a slight concussion upon the sides or end of the instrument may accomplish its dislodgment and prehension. This method generally succeeds; but if it does not, the beak of the lithotrite may be turned to the right or left; or the hips may be elevated so as to throw the stone toward the fundus of the bladder, and a repetition of the manœuvre may be more successful. Mr. Guthrie changed the direction of his instrument only when it was closed; a practice which Civiale declared injudicious, since the sliding of the blades after the stone was felt is very apt to change its position, and perhaps to remove it altogether from the grasp of the instrument.

Heurteleup's method, above described, is admitted to be both simple and efficient. It is liable, however, to the objection that, in certain irritable conditions of the bladder, it may cause considerable pain, accompanied with spasmodic contraction in consequence of the pressure made upon this viscus during the introduction of the instrument, and until the stone is seized.

The stone being crushed, if the operation has occasioned but little or no irritation, and the patient gives no sign of weariness, the blades may be opened and the operation repeated upon the fragments, a second or even a third time. The blades should then be closed, the end of the instrument slightly concussed to complete the disengagement of the fragments, and carefully withdrawn.

The patient should now be placed in bed, and allowed to take a glass of hot gin and water in sufficient quantity to encourage sleep and a gentle perspiration. By this means the irritability of the bladder will be made to subside more quickly, and the chill, which occasionally results, may be obviated. No stimulants should be allowed subsequently; the diet should be simple, and water alone may be drunk freely. In order to prevent the lodgment and impaction of fragments in the vesical portion of the urethra, the patient should evacuate his bladder while lying upon his back in bed.

Fig. 422.



Seizure of the Stone by Heurteloup's Method.

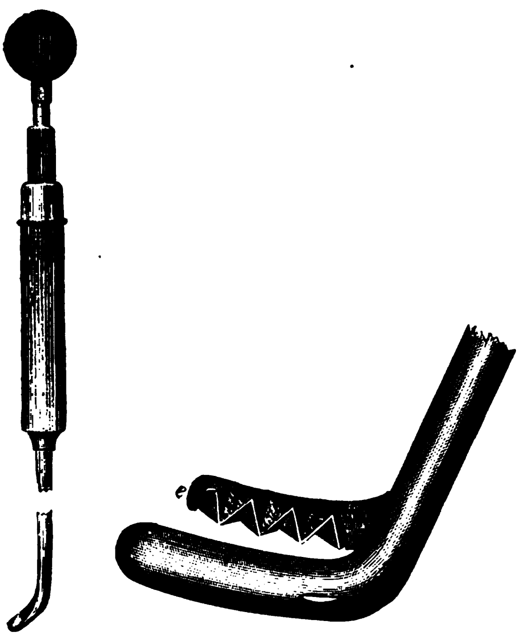
The interval between the first and second operation will be more or less prolonged according to the condition of the bladder. In general it may be stated that the operation is not to be repeated while fragments are passing daily, and perhaps not until two or three days have elapsed since they ceased to pass. If fragments do not escape after one or two evacuations of the bladder in the recumbent posture, the patient may be permitted to urinate standing, or the bladder may be injected with tepid water and then emptied rather suddenly while standing. If fragments become engaged in the vesical or membranous portion of the urethra, they should be pushed back by a large flexible catheter; but if they are lodged in front of the membranous portion they may sometimes be pushed forwards by careful pressure with the fingers; or they may be evacuated by checking the flow of urine by pressure made behind the fragment, and then allowing it suddenly to flow again.

The number of operations required is usually seven or eight; but in some cases the operation has to be repeated a great number of times before complete success is attained; and, in exceptional cases, when the stone is small and friable, a single operation is sufficient.

Dr. Bigelow's Method (Litholapaxy).

Most surgeons have thought that in the operation of lithotripsy instrumentation ought not to be continued beyond a period of three minutes, lest it cause excessive irritation, to be followed probably by cystitis. They have therefore made it a rule, liable to few exceptions, to withdraw the instrument at the end of this period, even though the stone may not have been crushed or even seized, deeming it more prudent to wait a few days until the irritation has ceased before repeating the operation. They have proposed therefore only to complete the removal of the stone through several successive operations.

Fig. 423.



Bigelow's Lithotriptor.

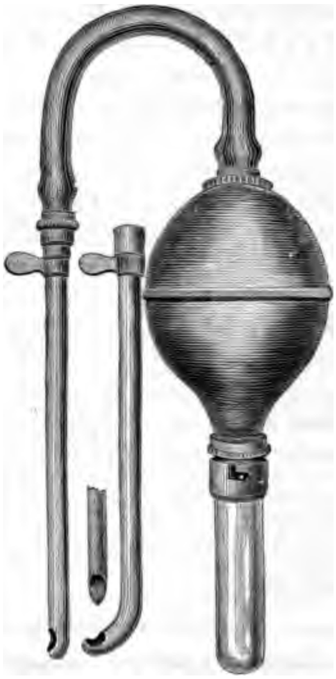
Professor Bigelow, of Boston, thinks that he has demonstrated that the period of instrumentation may be very much extended, and that, if necessary to the completion of the fragmentation and removal of the calculus, it may be safely extended to one or even two hours. Indeed he insists that it is much safer to remove the calculus at one long sitting than to accomplish the same purpose in several short sittings, provided only the proper instruments be employed.

To this end he has modified the instruments and the apparatus to be employed both in the crushing and in the removal of the fragments. The écraseur or lithotriptor is larger and stronger; and the teeth are arranged in such a manner as to more effectually prevent the fragments from becoming entangled in the blades of the instrument.

Prof. Bigelow has also modified and essentially improved the apparatus employed in the immediate removal of the fragments. Similar apparatus had been devised by Clover, and Nélaton had suggested the use of a metallic pump in place of the rubber ball used by Clover. Tillaux, Dittel and Colin have sought to accomplish the same end by other forms of apparatus, but none of them have so effectually overcome the most serious difficulties as has Prof. Bigelow's apparatus.

In using this apparatus, a large-sized catheter, either straight or slightly curved at its vesical extremity, is introduced into the bladder, the rubber bulb is filled with warm water, and the catheter is connected with the flexible tube which is attached to the bulb. By pressing upon the bulb the water is driven into the bladder, and on relaxing the pressure it is returned to the bulb conveying the débris, which drops into the glass bottle attached to the bulb. This process is repeated until the débris is all removed from the bladder.

Fig. 424.



Bigelow's Evacuator.

It has not been claimed that this method of rapid operation, called by its inventor *litholapaxy*, is wholly free from danger, but only that it is less dangerous than either of the methods of lithotripsy hitherto practised. It is easy to conceive that in a certain proportion of cases, and especially when there is much irritability of the urethra and of the bladder, the introduction of such large instruments, and the violent and prolonged irrigation of the bladder by which the sharp fragments are projected against its sensitive coats, will determine serious inflammatory reaction. The question is whether the liability to such accidents is less than when less violence is used, and the operation has to be several times repeated, and the fragments are permitted to escape, almost unaided, through the urethra. Whatever conclusions may be drawn from the theoretical argument, in reference to the method of the distinguished Boston surgeon, and notwithstanding it has received the approval of some of our best surgeons, and has satisfactorily borne the test of considerable clinical experience, it would be premature to declare for it unequivocally, at present, superiority over all other methods.

Dr. Moore's Method (Scraping).

Dr. E. M. Moore, Professor of Surgery in the University of Buffalo, N. Y., has devised an instrument for grinding, or, more properly, *shaving* down the stone in the bladder, which is exceedingly ingenious, and which has already been employed by him successfully. A report of the case, with a full account of the instrument, may be found in the Transactions of the American Medical Association for 1870.

Dr. Moore says he has long been convinced that lithotrity (or lithotripsy) cannot become a successful rival of lithotomy until the process can be completed at one sitting. Lithotomy is a violent procedure, but it has its compensation in the fact that by this method the foreign body is at once and wholly removed. With Dr. Moore's instrument, however, it is proposed to reduce and remove the calculus in one operation.

The striking feature in Dr. Moore's instrument is a steel net, which is made to open after it has entered the bladder, and by which the stone is seized and held until it is completely reduced. "The stone, enclosed within the net and drawn to the end of the instrument, is rubbed down by a series of scrapers, which cut its proximate face. The scrapers are not to be confounded with drills, after Civiale's first manner, which penetrated the stone, so that its honey-comb condition would cause it to break; they remove the surface, and are intended to cut the whole face of the calculus, and not to go through it. There is no difficulty in doing this with the chisel-shaped points, or their surfaces, and that too with rapidity, while the bladder is perfectly protected by the steel net."

Another instrument has also been constructed by Dr. Moore, "a steel catheter, strong enough for a crushing lithotrite, provided at the neck with a small Jacobsen's loop, which develops a large catheter eye." The instrument first described, having been closed and withdrawn, this second instrument is introduced, "and those fragments which cannot pass are at once crushed, and the stream is very likely to wash them under the loop. Provision is also made for a double stream."

I am not informed that any other successful cases have been reported, either in Prof. Moore's experience or in the experience of other surgeons, and it is believed that the method has been for the present practically laid aside.

Dolbeau's Method (Called by him "Perineal Lithotrity.")

Dolbeau's method I speak of in this connection only to say that, like Bigelow and Moore, he has sought to remove the stone in a single sitting, by a combination of lithotomy and lithotripsy. He cuts through the perineum into the membranous portion of the urethra, dilates the prostatic portion of the canal, with a powerful écraseur breaks the stone and then washes out the fragments. The operation has very little to recommend it, and has not been generally adopted.

Lithotomy. Syn., Lithotomia, R. O.

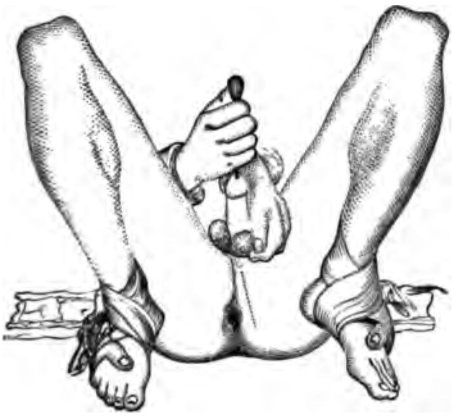
The operation of cutting for stone in the bladder is mentioned by Hippocrates as having been practised by certain itinerants in his day; but with so little success that he required his pupils to take an oath never to cut for stone in the bladder. Celsus first described and recommended the operation; declaring, however, that it was only applicable to persons under fifteen years of age. At a later day Mariano Santo performed lithotomy at all periods of life; and his name is perpetuated in the "Marian" operation, which is essentially the same as the "median," lately revived by Allerton and others. Since this time lithotomy has been practised in a great variety of ways, both upon the male and female. In the case of the male, to whom for the present our remarks are confined, the operations may be classified as infra-pubic, or perineal, recto-perineal, and supra-pubic. The methods of operating by the perineum are especially numerous; but inasmuch as a large proportion of these latter have long passed into disuse on account of the dangers or difficulties which attend them, only a few will need to be described.

Oblique Lateral Operation. Syn., Lateral; Ab alterutro latere, R. C.; Lateralized. Cheselden's Operation.

This operation was not invented by Cheselden, but having been particularly described and very successfully practised by this great English surgeon and anatomist, it has, very properly, borne his name. As it was one of the earliest operations practised by surgeons, so also it has for the longest period retained its reputation. In every successive generation surgeons have invented new, or have revived, with certain modifications, old incisions, and secured for their novelties attention with temporary fame; but as often public sentiment, in the end, has reaffirmed its general preference for the operation of Cheselden.

Preparation for the Operation.—No doubt much of the success of certain operators has depended upon a careful attention to the general condition of the patient, and of the bladder especially, before undertaking the operation; although these considerations, it must be admitted, are of somewhat less importance in relation to lithotomy than when it is proposed to make the operation of lithotripsy. It may not be possible always to re-establish, in all the organs of the body, the perfect performance of their respective functions, especially while the calculus remains in the bladder; but as far as practicable this should be done by such measures as the judgment of the surgeon may suggest.

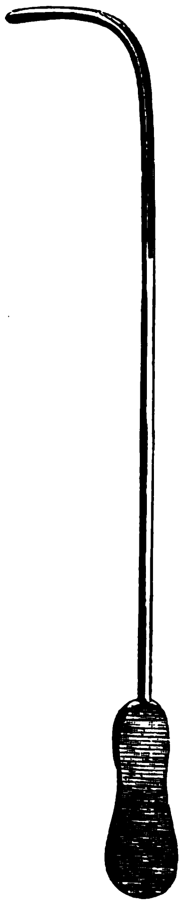
Fig. 425.



Cheselden's Operation.

The position, size, and chemical character of the stone should be learned by exploration, and by chemical analysis of the urinary sediments; on the morning preceding the operation, the bowels should be emptied by a gentle cathartic; three or four hours before operating, the rectum should be washed out by an enema of tepid water, and farther alvine movements prevented by the exhibition of from one-quarter to one-half a grain of opium by the stomach. Smaller doses, it is unnecessary to say, would be required for children and infants. The patient should be directed to retain his urine from the time the rectum is emptied by the enema; and if it is found that he has been unable to do so, six or eight ounces of tepid water should be injected before the operation is commenced. He must then be placed upon a suitable operating table, or upon an ordinary, firm kitchen table, properly prepared with folded blankets and pillows. When anæsthetics are not employed, the hands must be made fast to the feet by ordinary cotton or flannel rollers, in the manner represented in the preceding wood-cut; but when anæsthetics are used it is unnecessary to "tie" the patient. The following assistants are required, one to stand upon the right side of the patient, facing the operator, with his left elbow thrown over the patient's right knee, and thus supporting the knee against his side, while his right hand grasps and steadies the right foot; a second upon the left side of the patient, facing in the same direction as the first, and supporting the left knee and foot in a similar manner; a third standing behind the first assistant, on the right side of the patient, holding the scrotum with his left hand, and the staff with his right; a fourth in charge of the sponges and ligatures, and, when anæsthetics are used, a fifth to administer this agent. The instruments in this operation, as in most other capital operations, ought never to be intrusted to an assistant, but they should be brought within easy reach and observation of the surgeon, on his right hand side.

Fig. 426.

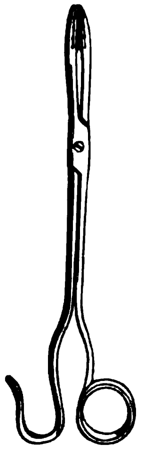


Gross's Staff.

The **instruments** required will depend in some measure upon the choice of the operator. Those which may be regarded as essential, and in general to be preferred, are:—First, a full-sized staff, with a deep and broad groove; the groove being constructed upon its convex surface, commencing at about the middle of the shaft, and terminating in a complete cul-de-sac nearly half an inch from the distal extremity. Mr. Fergusson and some others prefer that the groove shall be upon the left side of the instrument. Gross places it a little on the left side. Mr. Key used a straight, and Mr. Buchanan, of Glasgow, recommends a rectangular staff, and this latter has been modified by Hutchison and Corbett. Dr. Mason, of Brooklyn, has contrived a very ingenious instrument, which is at the same time a sound, a catheter, and a staff. Second, an ordinary sharp-pointed bistoury. Third, a probe-pointed bistoury, called a "lithotomy knife," or "beaked knife;" and according to my experience there is no better lithotomy knife than that employed by Mr. Key. Sir Henry Thompson uses a very similar instrument. I have, however, several times used the same knife with which I have made the first incisions; and Mr. Brodie, also, did not regard the probe-point as essential, but an instrument with a sharp, cutting extremity might not be safe in the hands of an inexperienced or unsteady operator. Fourth, lithotomy forceps, and scoops, and of these a considerable variety are needed, namely, straight and curved, small and large, with forceps, also, for crushing the stone.

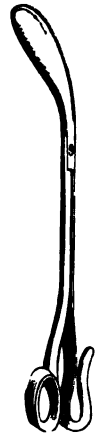
The old cutting gorget is still in use by some surgeons, but its original form is considerably modified. Physick's gorget, formerly much used by American surgeons, is composed of a shaft, handle, and two or more movable blades, for adaptation to children or adults, and cuts only by its anterior oblique edge, as it is thrust forwards into the bladder. We have used this instrument, and can speak of the facility and safety with which it may be employed, when care is taken to keep the beak of the instrument in the groove of the staff, and when, by depressing well the handle of the instrument as it enters, the danger of slipping between the bladder and rectum is avoided. A single lithotome caché has also been sometimes used, which, like Dupuytren's double lithotome caché, cuts only while the instrument is being withdrawn from the bladder.

Fig. 427.



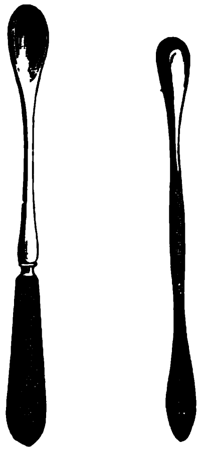
Straight Lithotomy Forceps.

Fig. 428.



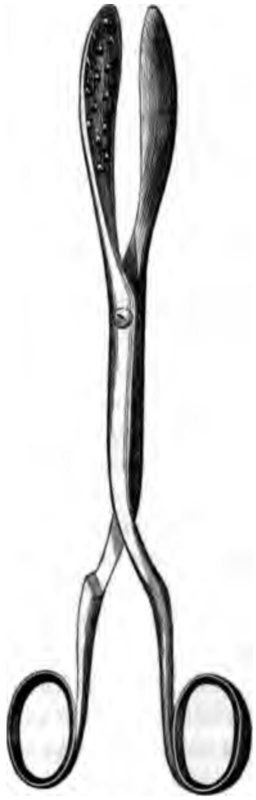
Curved Lithotomy Forceps.

Fig. 429.



Scoops.

Fig. 430.

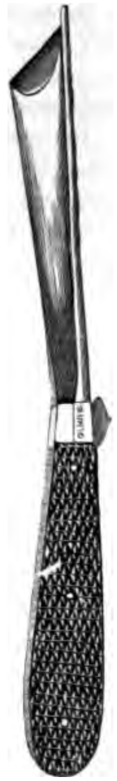


Large Serrated Lithotomy Forceps.

In addition, the surgeon should be supplied with Physick's artery forceps; a large syringe; a silver canula, or an ordinary female silver catheter covered, except at its two extremities, with a muslin shirt or sac, closed upon the catheter just above its eye, and open at the top. This latter is an ingenious plan, devised, we believe, by Dupuytren, for arresting hæmorrhage in deep-seated vessels, when they cannot be secured by the ligature. The instrument, thus enclosed, being thrust through the wound into the bladder, the open extremity of the sac is filled with lint, which, being carried well up by the probe, compresses the bleeding vessels, while it does not interfere with the free escape of the urine through the catheter.

Operation.—The patient, placed upon his back, in the position already described, and with his buttocks resting well over the end of the table, the operator introduces the staff into the bladder, and feels for the stone; then, committing the staff to an experienced assistant, he directs him to hold it with his right hand perpendicular to the body, so as to make sure that its beak is kept well in the bladder, while at the same time the convexity of the curved portion is inclined a little to the left, and pressed slightly toward the perineum in that direction. With his left hand the assistant will now draw up the scrotum and expose the perineum to the operator.

Fig. 431.



Physick's Gorget.

All the other assistants being in their assigned positions, the operator, seated upon a low stool, commences the incisions with the common bistoury, in the median line, or a little to the left of the median line, and, in the case of an adult, about one inch and a half in front of the anus, and, carrying the knife obliquely downwards and outwards, he terminates this first incision opposite the posterior margin of the anus, and nearly midway between the anus and the tuberosity of the ischium, but rather nearer to the latter than to the former. If the patient is fat, and the perineum is supposed to be deep, the length of the incision posteriorly may be increased by half an inch or an inch. Thus far the skin, cellulo-adipose tissue, and the superficial fascia have alone been divided.

The second incision commences half an inch lower than the first, and the knife is at first pressed rather to the left of the bottom of the wound, to avoid the bulb of the urethra and its artery. As it descends it is carried more deeply, and the incision is finally terminated below, at a point a little short of the first incision. The operator has now divided the deep layer of the superficial fascia, the transverse perineal muscle and its accompanying artery, with a mass of cellulo adipose tissue, and has approached the membranous portion of the urethra in front of the prostate gland. During this part of the operation the surgeon will guide his knife more accurately, and escape the accident of wounding the rectum, if he places the forefinger of his left hand in the rectum, and opens the lips of the wound gently by the thumb of the same hand; but he must be careful not to disturb too much the natural position of the parts by manipulations of this kind.

Third incision. The forefinger of the left hand, being withdrawn from the rectum, is introduced into the wound and carried upwards and backwards toward the convex portion of the staff; and when the nail of the finger has lodged in the groove, the knife is inserted, and, guided by the finger-nail, penetrates the membranous portion of the urethra, making an incision of about half an inch toward the prostate. That the knife has entered the urethra will be indicated by the escape of urine.

The fourth incision is made with the lithotomy knife, the beak of which is lodged in the groove of the staff through the opening made by the bistoury. The assistant now relinquishes the staff to the operator, who, seizing it firmly with his left hand, moves the lithotomy knife backwards and forwards to make certain that it still rests in the groove, and then slowly and steadily carries it forwards into the bladder, with the edge inclined obliquely to the left side, depressing the handle as the point advances, and at the same time depressing slightly the handle of the staff in order that its beak may be kept well in the bladder. It is intended to divide the prostate to the extent of from two to six lines, according to the size of the stone, and in that direction—obliquely downwards and outwards—in which the external incision has been made. If by this moderate incision of the prostate the opening is found to be not sufficiently large, it will be better to enlarge the opening with the finger, or with a blunt gorget, or even by incision of the prostate upon the opposite side, rather than incur the risk of urinary infiltrations, which are almost inevitable when the prostate is completely divided, and the pelvic fascia is cut. Withdrawing the knife, taking care at the same time not to enlarge the opening in the prostate as the knife recedes, the staff is retained in the bladder by the assistant until the forefinger of the left hand of the operator is introduced and the stone is felt, or until it is ascertained that it is beyond the reach of the finger. If the stone can be felt, its position and size may be determined and some judgment may be formed of the practicability of removing it by the present opening. This examination may also decide the choice of forceps; but in general those which are long and slender, having a slight lateral curve, will be preferred.

The staff is then withdrawn and the forceps introduced beside the finger, taking great care not to press the forceps against the outside of the bladder or between the bladder and rectum. In children the stone can sometimes be reached by the finger and thrust between the blades of the forceps; but this is not generally the case; and it is precisely in these examples that we are likely to experience the greatest

difficulty in seizing the stone—for the reason th
the stone is apt to be small and the bladder not g
the stone lies usually remote from the neck of
fundus, or it is easily displaced in that direction.
often, also, in older persons when the bladder is i
and in such cases we are most aided by pressing
the pubes, or by elevating the shoulders well,
almost into the sitting posture, when the calculus
fall toward the neck. We may also, in some
culus and bring it within the reach of the fo
finger introduced into the rectum.

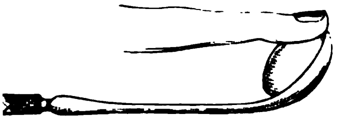
We wish it to be understood that no part of the
exacts more skill, delicacy, and patience than the
and it has happened more than once that the mo
surgeon has failed to find a stone which the se
shown to be present and lying loose in the cavi
bladder. The forceps must be introduced closed
moment the stone is touched they should be ope
fully so as not to displace it, and the blades dep
either side until it is within their grasp; or, if
cedure fails, the open blades may be pressed ag
posterior wall of the bladder so as to cause a dep
pocket into which the stone may fall.

When the calculus is seized it must be held rath
lest it should be broken; the occurrence of which
sometimes causes serious complications, on accou
difficulty of seizing small fragments, or the imp
of deciding when they are thoroughly remove
are apt to become lodged in the folds of the bla
the attempt to remove them, whether by the f
syringe, prolongs the operation and occasional
considerable irritation. Forceps have been co
with open fenestræ and lined with flannel or
diminish the danger of fracture, to prevent the st
slipping, and to lessen the diameter of the in
when the stone is grasped.

No attention need be paid to the manner in wh
so far as its diameters are concerned, provided the
large for its easy removal; but if, by the wide se
of the instrument, a presumption arises that it is
out without the employment of improper force,
deposited again upon the floor of the blad
made to seize it in such a manner that its long
with the shaft of the instrument. This change
times be accomplished with the index finger, w
neum, the stone is brought to the neck of the

ithdrawing the instrument, some obstruction is experienced at the neck the bladder, its escape will be facilitated by a slight oscillatory movement, or by depressing the handle of the forceps. In the case of a child, when the stone is small and movable, the scoop will sometimes be found the most convenient instrument for extraction.

Fig. 433.

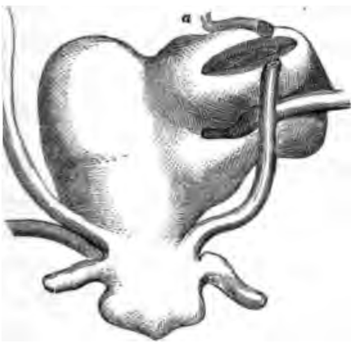


Lithotomy Scoop.

The stone being extracted is to be once examined to ascertain whether it is broken and any fragments main; and to determine by the absence or presence of facets whether her calculi are present. If fragments are supposed to have been left, ey are to be washed out by tepid water injected through the wound, by the use of the scoop. When no complications exist, and when accidents have happened, the operation is now completed, and the tient is only to be laid in bed, resting upon his back, with the knees ghtly elevated by pillows and separated moderately. It is scarcely cessary to remind the operator that arrangements must be made protect the bed from the urine which will, for a few days at least, cape by the wound.

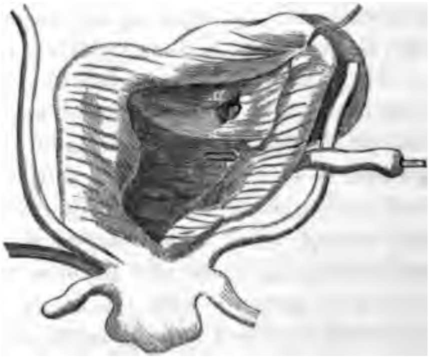
Until quite recently most operators have thought it necessary to troduce into the bladder, through the wound, a full-sized gum-elastic be, in order to lessen the danger of urinary infiltration. For some ars we have omitted to do so, and we have seen no reason to regret e omission; we think, also, that most American surgeons adopt the me practice. The objection to the introduction of a tube in these ses is the same which has already been stated in the treatment of inshot wounds of the bladder; it causes some irritation, and experience ems to have shown that it is unnecessary.

Fig. 434.



ysted Stone. Exterior of the Bladder. Calculus seen through incision at *a*.

Fig. 435.

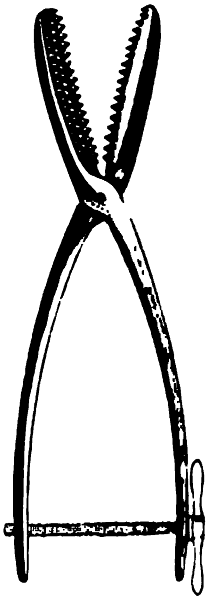


Interior of the same. *a*, orifice leading to cyst; *b* ureter.

When the calculus is **encysted** its extraction ought not to be atmpted, unless it be by the high operation; but this fact may not be known until the bladder is opened; and in case the operation has been attempted below the pubes, a careful exploration should be made with the finger or an exploring instrument, to determine the size of the opening in the cyst, and the feasibility of the removal of the stone through the perineal incision; and by the knowledge thus obtained the subsequent conduct of the surgeon must be governed.

If the stone is found to be very large, exceeding, for example, one inch and a half in its shortest diameter, and cannot be removed by the incision already made, either one of the following alternatives may be considered: the calculus may be broken by the stone-crusher, and thus reduced into fragments sufficiently small to admit of extraction; the probe-pointed lithotomy knife may be introduced into the bladder and the prostate incised obliquely downwards and outwards upon the right side, in the same manner that it has already been divided on the left: the recto-vesical operation may be made, or in the female, the recto-vaginal; or, finally, the high operation may be preferred. All these alternatives have been practised with success; and it will be most safe to leave the choice to the operator.

Fig. 436.



Stone-Crusher.

Hæmorrhage.—In the large proportion of cases no vessels are cut in this operation which require the ligature; but, if the artery of the bulb is divided before its final distribution, or the internal pudic is cut—as has happened a few times—a very troublesome hæmorrhage is inevitable. Occasionally, also, other vessels, such as the inferior hæmorrhoidal, the transverse perineal, or a venous plexus lying about the prostate, in old people especially, are the sources of the bleeding and demand interference. In the case of superficial vessels there is usually no difficulty in applying the ligature; but when the source of the hæmorrhage is in the deeper portions of the wound, a ligature can seldom be applied. Physick's artery forceps, or some other instrument constructed to hold a needle armed with a stout ligature, is sometimes useful in these emergencies; but since it is almost impossible to determine the precise source of a deep hæmorrhage, they cannot often be employed successfully. There are two expedients which give the best promise under these circumstances, namely, continuous pressure with the finger, made by a relay of assistants; or the canula enclosed with a sac in the manner which has already been described. This latter being introduced well into the bladder through the wound, the operator proceeds to stuff the sac, outside of the canula, with lint, either dry, or moistened with the persulphate of iron, until the compression is deemed to be sufficient.

If this proves successful, a portion of the lint may be removed as early as the second day, so as to diminish the pressure, but the canula should not be disturbed until the seventh or tenth day, when it will be found loosened by the suppuration.

Median Operation. Syn., A Mediâ Parte, R. C.; Marian Operation.

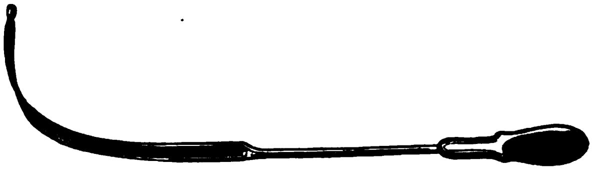
This process—the essential peculiarities of which consist in making the primary incision vertical, or in the line of the raphe, in front of the anus, and dividing longitudinally only the membranous portion of the urethra—was probably in use as early as the 14th or 15th century, but Mariano Santo first published an account of it about the year 1535. Since then the operation has undergone many modifications, the last of which was in the hands of Mr. G. Allarton, of England, in 1854.

Mr. Allarton's operation is as follows:—The patient being prepared and placed as for the lateral incision—with an ordinary grooved staff introduced into the bladder, and intrusted to an assistant—the index finger of the left hand of the operator is introduced into the rectum, and its extremity made to rest upon the apex of the prostate for the purpose of guiding the knife to the membranous portion of the urethra and protecting the rectum. A straight-backed, sharp-pointed bistoury, held in the right hand, with its cutting edge directed upwards, is then entered half an inch in front of the anus, and thrust forwards in the direction of the point of the finger resting upon the apex of the prostate, so as to enter the groove of the staff through the membranous portion of the urethra directly in front of the prostate. When, by the escape of urine, the urethra is ascertained to be opened, the knife is withdrawn slowly, pressing its edge at first and for a short distance against the groove of the staff, so as to enlarge the urethral incision; and again as the knife approaches the surface it is carried upwards a short distance along the raphe, so as to enlarge in this direction the tegumentary incision. A long probe is then introduced into the bladder, guided by the staff, and the staff withdrawn. The index finger of the left hand, well oiled and guided by the probe, is next gradually pressed through the wound and prostatic portion of the bladder, and the probe being withdrawn, the finger remains as a guide for the forceps. The remaining steps of the operation and the subsequent management of the patient are the same as in the Cheselden operation. Mr. Erichsen prefers, for the performance of Allarton's operation, Buchanan's rectangular staff.

The advantages which may properly be claimed for the median over the oblique incisions are, that no vessels of sufficient size to cause a dangerous or even troublesome hæmorrhage are liable to be wounded the pelvic fascia is not exposed to incision, and deep urinary infiltrations are therefore less liable to occur; and occasionally there is presented the further advantage, that the patient retains control of his bladder from the time of the operation until the cure is effected.

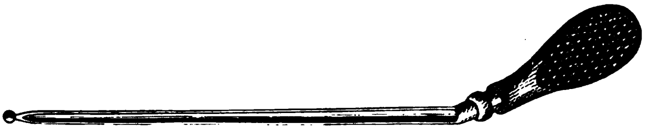
Its disadvantages are, the impossibility of removing so large a stone as by the oblique incision; the somewhat increased danger of wounding the rectum, and of causing contusion and laceration of the prostatic portion of the urethra during the extraction, or in introducing the finger for the purpose of accomplishing the dilatation. Dr. Markoe, one of the surgeons to Bellevue Hospital, and Dr. Little, of St. Luke's Hospital, have both expressed a preference for the median operation, after considerable experience; the former gentleman having made 13 operations with no deaths, and the latter 12 operations with two deaths.[1] It is to be remembered, however, that of Dr. Markoe's patients, 10 were under thirteen years, and none of them over thirty; and that of Dr. Little's, all the successful cases were under 10 years, while the two remaining patients—aged respectively 67 and 56 years—died. Dr. Little has gathered from American surgeons 96 cases of median operation, with only 3 deaths. We need not say that statistics of this kind, gathered from various sources, possess very little value as a means of determining the mortality of any operation. My own judgment of the operation is, that it is unsuited to the extraction of large stones, and that its proper application is limited to the removal of small stones in children.

Fig. 437.



Markoe's Staff with Broad Groove.

Fig. 438.



Little's Staff for Allarton's Operation.

Dr. Markoe uses a very wide and shallow staff in order to present a larger surface for the point of the knife; his staff differing in no essential respect from that which I have used for many years in the oblique lateral incision, and for which I have already expressed my

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[1] Markoe, *New York Med. Jour.*, April, 1867. Little, *Trans. Amer. Med. Assoc.*, 1870.

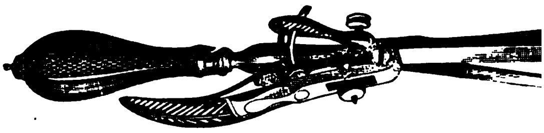
by the French. It is adapted to the removal c
but the tegumentary incisions are necessarily
incisions made in Cheselden's operation, and c
the same freedom of manipulation.

Bilateral Operation. Syn., Ab Utroque

Many interpreters of the writings of Celsu
scribed this operation as a crescentic incision in
that to him alone is due the credit of bilateral s
much later day, practised the operation. Bécla
verse crescentic incision, employing a double-ed
of a sage leaf, to divide the prostate. Modern su
the French, have, however generally practise
according to the method recommended by Dup

Dupuytren's Method.—A crescentic incisio
in front of the anus, the two extremities of wh
side, midway between the anal aperture and
ischium, or a little nearer to the ischium than t
branous portion of the urethra being reached an
lithotome caché is introduced closed into the
its concavity directed upwards; when it h
bladder the instrument is turned upon itself, s
upwards, and the blades are expanded by the g
upon the lever; with the left hand the shaf
sustained, and pressed somewhat firmly against
prevent any lateral displacement, and the lithoto
drawn. During this retrograde movement the ha
lowered between the thighs. By this method the p

Fig. 440.



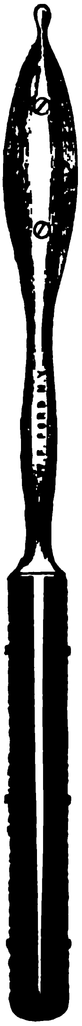
Dupuytren's Double Lithotome Caché

obliquely downwards and outwards on both sid
may be required, or which may be deemed prope
blades, and consequently the size of the prostat
lated by a movable stop. If the operation is p
artery of the bulb, with the transverse and s
avoided, and a larger opening is made in th
the urethra than by any other method.

I have never practised Dupuytren's oper
subject; but frequent experiments upon the
strated one defect, to which, so far as I am i

not hitherto been called. The blades are long and slender, and yield readily under pressure; consequently, if there is the smallest difference in the sharpness of the two blades, or in the resistance offered by the two sides of the gland, the incisions will have unequal depth. It will frequently happen in the cadaver that one lobe is nearly severed while the opposite is only notched. That the same is liable to occur in the living subject, when sometimes one lobe is indurated while the opposite may be in a normal condition, has seemed to us a proper and inevitable conclusion. Nevertheless its advocates are numerous, and some of them are deservedly distinguished for their large experience and success in lithotomy; and especially is it proper to mention that the operation has been made 78 times, in persons of all ages, by Dr. Paul F. Eve, of Nashville, Tenn., of whom only 8 have died; a success which has rarely if ever been attained by any other operator, and which justly entitles him to the position he has so long occupied as one of the most skilful of American surgeons.

Fig. 441.



Dr. Wood's Bisector.

Many operators who adopt the bilateral section, imitating the practice of Béclard, employ a bisector with fixed open blades, which, like the gorget, cuts as it enters the bladder. An instrument constructed upon this plan was employed by the late Dr. Alexander Stevens of this city, and by the late Dr. James R. Wood, of Bellevue. The length of the handle, and the breadth of its blade, must be adapted to the circumstances of the case.

Other Perineal Operations.

Operators seem to have exhausted their ingenuity in devising new modes of opening the bladder through the perineum for the purpose of removing calculi. In addition to those which have been described, it will be more curious than important to mention that Senn divided the left lobe obliquely downwards and outwards, and the right horizontally; Vidal de Cassis made a quadrilateral section of this gland, cutting obliquely upwards and outwards upon both sides, and also obliquely downwards and outwards; while Vacca cut directly downwards. These processes, and many more which might be enumerated, possess no farther claim to consideration.

Recto-Perineal Operation. Syn., A Parte Perinei et Recti Intestini, R. C; Recto-vesical.

The facility with which the bladder may be reached from the rectum, and the fact that no important blood-vessels are exposed in the recto-vesical incision, have probably constituted the principal grounds which, in the opinion of a few operators, have justified a resort to this method. Tradition speaks of it as a method which had been practised in Egypt; but to M. Sanson is due the credit of having secured for it attention and considerable reputation, during the early part of the present century.

Sanson cut in the trigone, the incision including the upper portion of the prostate gland; but Vacca modified the operation considerably, making the incision lower, so as to incise only the urethra and the apex of the gland. Both operators employed a grooved staff, dividing the upper wall of the rectum and sphincter ani, including a portion of the perineum, in the median line.

The objections to this operation are apparent. The rectum being wounded, a recto-vesical fistula may result; the seminal ducts and vesiculæ seminales are liable to be cut; and, in Sanson's operation, the cavity of the peritoneum may be laid open and fatal extravasations ensue. Experience, moreover, has demonstrated that the fatality of the operation exceeds that of most other methods.

Supra-pubic or High Operation. Syn., Supra Pubem, R. O.; Hypogastric Operation, Epicystotomia.

Franco was probably the first to make this operation, an account of which he published in 1571; but he was careful to warn others not to imitate his example. Soon after, however, Rousset recommended its general adoption; and at several successive periods, since his day, the operation has obtained considerable favor. A few surgeons have constantly maintained its superiority to all other methods, while the large majority have only admitted the justness of these claims under special and exceptional circumstances.

In case the stone is very large, or the lower pelvic openings are much narrowed, or the coxo-femoral articulations are anchylosed in such a position that the perineum cannot be properly exposed for a sub-pubic, rectal, or vaginal operation, the high operation will remain as the only alternative.

There are two principal sources of danger in the high operation; namely, urinary infiltration, and opening into the cavity of the peritoneum. The first is to be avoided by dorsal decubitus during 48 hours, and occasional introduction of a catheter; in reference to the second it must be admitted that it is in certain cases with difficulty avoided. I have seen it happen in the hands of an experienced and skilful surgeon, and that, too, when he had just assured us that there was no danger of this accident where proper care was employed. In women, and in males under the age of 20 years, the bladder lies well above the pubes, and the reflection of the peritoneum may, with moderate precautions, be avoided. Pitha states that prior to the eighth year of life, the peritoneal reflection from the bladder does not reach generally lower than one and a half or two inches below the navel. But in children vesical calculi are usually small, and the perineal operations are peculiarly free from danger; and in women we have other methods of operating far less hazardous than the high operation. It is in old men especially that we are apt to find those large calculi which do not admit of being removed by sub-pubic incisions; but it is at this period of life, also, that the bladder is most often found low in the pelvis, and the vesico-parietal reflection of the peritoneum approaches nearest to the pubes.

Operation.—The bladder, emptied of its urine, is moderately filled with tepid water, and a sound introduced, the extremity of which is to serve in some measure as a guide to the knife in opening the bladder. An incision is now made above the pubes in the median line, of from two to three inches in length, between the pyramidalia, dividing the integument, aponeuroses, and exposing the subjacent areolar tissue. With a director, this tissue is opened from the pubes upwards and in the direction of the bladder, or in the direction indicated by the beak of the sound pressed firmly forward over the pubes. As soon as the bladder is exposed, it is opened by a vertical incision and the two margins secured by long, toothed forceps, or by stout ligatures, which are to be held carefully by assistants until the stone is removed. The extraction of the stone by straight forceps is now easily accomplished. If any difficulty is experienced in introducing them, the opening in the bladder should be rendered more patulous by the use of retractors.

Calculi in the Kidneys.

Surgeons have occasionally incised the walls of the abdomen, upon the outer margin of the lumbar muscles, for the purpose of removing renal calculi (nephrotomy); but neither the earlier records nor the later operations of such excellent surgeons as Thomas Smith and Durham, of London, and of Peters, Gunn and Dawson, of this country, have demonstrated the propriety of incisions in these cases, except where the presence of a renal or of a supra-renal abscess clearly indicates their necessity. In case, also, a renal calculus can be felt in the track of a lumbar sinus, it may be removed with forceps, aided, perhaps, by dilatation.

Calculi in the Prostate Gland.

According to Virchow, certain prostatic calculi consist originally of organic matter, derived from an insoluble protein substance and semen, upon which is subsequently deposited the phosphates. They occupy the follicles of the gland, and are found to vary in number from one to fifty, or more, and are of various sizes, ranging from a poppy-seed to a cherry-stone. In a few cases a single calculus has been found much larger. In form they are usually irregular, presenting several facets where they have come in contact with each other. They occur most frequently in old persons, but are occasionally met with in youth.

In other cases prostatic calculi, having originated in the kidneys or bladder, become lodged in the prostatic portion of the urethra, and by their pressure cause ulceration, and finally become embedded in the substance of the gland; or a vesical calculus, resting against the neck of the bladder, may become prolonged into the prostatic portion of the urethra, when it is liable to assume the form of a dumb-bell, being expanded at both extremities.

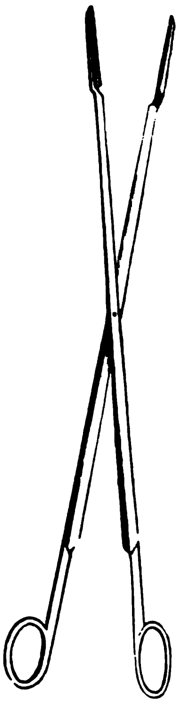
Treatment.—When they are small and cause little or no irritation or obstruction, they may be permitted to remain. If found to be loose and small they may be extracted by urethral forceps, or thrust back into the bladder. When of moderate size and not loose, the median operation will suffice for their removal, but larger prostatic calculi demand the lateral oblique incision, the operation being made in the same manner as for stone in the bladder. When, by careful urethral and rectal examination, it is ascertained that the gland is filled with encysted calculi of a small size, it will be proper to consider whether relief can reasonably be expected from any surgical operation, since it will be scarcely possible to extract them all without complete destruction of the gland, and whether, therefore, it will not be most expedient to resort to palliative measures alone.

Calculi in the Male Urethra.

These accidents are most common in children. Usually the calculus has been formed in the kidneys, but it may have originated in the bladder, in the prostate gland, or in the urethra itself. Fragments remaining in the bladder after the operation of lithotomy or of lithotrity may become thus lodged and impacted. They are most frequently found detained in the sinus of the bulb, or in the fossa navicularis.

Treatment.—Holding the urine for a while, and then expelling it suddenly, will sometimes cause the expulsion of the calculus; or the surgeon may, while the patient is attempting to evacuate the bladder, close the canal by pressure with the finger above the point where the calculus is lodged, and then permit the urine to escape suddenly. A similar mode of pressing with the finger at the distance of an inch or more below the calculus has also succeeded. The calculus may in other cases be dislodged by pressing it forwards slowly and carefully with the finger.

Fig. 442.



Urethral Forceps.

If these expedients fail, an attempt must be made to seize the calculus with narrow urethral forceps. I have used successfully for the same purpose my own long, narrow bullet-forceps. When the calculus is lodged in the fossa navicularis, it may generally be extracted by a slender pair of dressing forceps. Finally, if arrested in the prostatic or membranous portion of the urethra, and it cannot be seized by the forceps, an attempt may be made to force it back into the bladder by a steel sound or a flexible bougie.

Incision must not be long delayed after all other expedients have failed, lest ulceration and urinary infiltration should ensue. That portion of the urethra which is anterior to the scrotum lies very superficially, and, when opened, urinary fistulæ are apt to result. Incisions through that part which is covered by the scrotum, are liable also to be followed by infiltration of urine into the loose areolar tissue; while as a consequence of incisions into the membranous portion, neither of these accidents are very liable to occur. It will be proper, therefore, to make an attempt to push the calculus into the membranous portion or into the sinus of the bulb, from whence it may be easily removed by cutting directly down upon it by a vertical incision, in the same manner as if about to make the median operation of lithotomy. In case it is needed, a sound may be first carried through the urethra, down to the calculus, the extremity of which will serve as a guide to the knife.

VESICAL CALCULI IN THE FEMALE.

Vesical calculi are much more rare in the female than in the male. The explanation of this difference is probably to be found in the fact that the female urethra is relatively short, straight, broad, and dilatable; and in the absence of any natural obstruction at the outlet of the bladder, such as the enlarged prostate of old men.

Spontaneous Expulsion.

Numerous examples are upon record of the spontaneous expulsion of large calculi through the female urethra. Bartholin mentions one thus expelled which was more than two inches in diameter. Collet speaks of one expelled which was of the size of a goose-egg. Many other equally extraordinary cases are upon record, and of some of them it is affirmed that the expulsion was not followed by incontinence of urine.

Extraction without Dilatation. Syn. Evulsio fragmentorum, R. C.

Certain small calculi may be removed from the female bladder entire, and without dilatation, by the common urethral forceps, by small, slender, and slightly curved lithotomy forceps, or by the lithotriptor, the patient having been previously fully anæsthetized. There is nothing in the operation which demands, in this place, further consideration.

Lithotripsy. Syn. Lithotripsis, R. C.

When calculi in the female bladder are too large to admit of removal by the preceding method, but have not attained great size, and are composed of the phosphates; or if they can be crushed by the lithotriptor, whatever may be their composition, this operation constitutes the only proper resort. Calculi which are the result of the presence of metallic or other hard foreign bodies introduced into the bladder by accident or intentionally, are of course not included in the above statement. In a few words, the rule which we think ought to-day to be regarded as absolute is, that calculi in the female bladder, which cannot be removed by forceps without dilatation, and which can be completely crushed, demand lithotripsy; and for this reason, all the remaining methods are more or less liable to be followed by urinary fistulæ or by permanent incontinence.

Dilatation. Syn., Lithotripsy. Dilatatio urinæ itineris fœminei, R. C.

Calculi not exceeding one inch in their shortest diameter may be removed from the female bladder by dilatation of the urethra. This may be accomplished by the introduction of metallic sounds, or of wax or gum-elastic bougies, occupying one or two weeks for the completion of the dilatation; or it may be effected in a few hours by the use of a conical sponge-tent; or, the patient being placed under the influence of an anæsthetic, the urethra may be dilated to the diameter of half or three-quarters of an inch, by the use of a Weiss's dilator. In the manner last described I have removed a calculus, measuring three-quarters of an inch in its shortest diameter, from a negro woman; and, after the operation was completed, while exploring with the index finger, the neck of the bladder was felt to contract with considerable force. The woman was laboring under chronic cystitis with pyelitis at the time of the operation; in consequence of which serious complications, rather than from any injury inflicted by the operation, she ultimately died; but to the moment of her death she was able to hold her water as well as, or even better than she could before the operation. The excessive irritability of the bladder, which would not allow of the daily introduction of instruments for the purpose of accomplishing gradual dilatation, determined me in the adoption of the method of rapid dilatation under ether; but her subsequent complete control of the urine has left a suspicion that, in this regard, rapid dilatation may have an advantage over gradual dilatation; although I very well understand that by neither method can incontinence be generally avoided. Dr. Emmet says that he has seen at least seven cases of incontinence caused by dilatation, and for which no relief could be afforded; and he declares that in his opinion this method is neither safe nor justifiable.[1]

Dilatation with Incision.

No doubt very large calculi may be removed by a very simple modification or supplementation of the process of dilatation, namely, incision of the mucous membrane. For this purpose a straight, narrow, probe-pointed bistoury is carried upon a straight, grooved director into the bladder, and the mucous membrane of the urethra divided as the knife is withdrawn with its cutting edge directed upwards. Fergusson thought it necessary to divide only the outer half of the urethral canal, the vesical portion being usually sufficiently dilatable without incision. After the mucous membrane has been incised, dilatation is again practised and the stone extracted.

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[1] *Vesico-vaginal Fistula, from Parturition and other Causes, with Cases of Recto-vaginal Fistula*; by Thomas Addis Emmet, M.D., p. 42. Wm. Wood & Co., New York, [illegible]

Lateral Oblique Operation.

For the removal of large calculi, most surgeons have hitherto preferred an operation essentially the same as the Cheselden operation in the male; and by this method I have several times been able to remove very large calculi from the female bladder.

The patient being placed upon a table, resting upon the back, with the legs drawn up and supported as directed in the operation upon the male, a straight staff having a deep and wide groove is introduced into the bladder and intrusted to an assistant. The index finger of the left hand is then laid against the upper surface of the vagina, to admonish the surgeon when the knife approaches too near the vaginal wall. With the right hand a narrow, straight, probe-pointed bistoury is carried along the staff with its edge directed outwards; and when the bladder is reached, the knife is again slowly withdrawn in the line of a curve embracing the vaginal wall, making an incision of about two inches in length upon the surface, but of not more than one-quarter of an inch at the neck of the bladder.

In women who have borne children, the urethra encroaches a little upon the upper wall of the vagina; and the edge of the knife must therefore be directed at first upwards and outwards, in order to avoid a wound of this canal.

Vesico-Vaginal Operation.

Occasionally, from a very early period, vesical calculi have been extracted through the vagina: but at no time has this method of procedure secured for itself the general favor of surgeons, it having always been considered as a sufficient objection that the operation had in most cases been followed by a vesico-vaginal fistula; so that such calculi as could not, on account of their size, be removed by one of the several methods already mentioned, were assigned to the high operation as the only remaining alternative. It would seem, however, that this question is to-day entitled to a reconsideration, inasmuch as the wonderful achievements of modern surgery in the closure of vesico-vaginal openings, have removed, in a great measure, the only serious objection to the vaginal incision. In defence of the high operation it must be stated that the pubes is lower, and the bladder more advanced, in the female than in the male; and that, in consequence of these anatomical differences, the difficulty of reaching the bladder without wounding the peritoneum is greatly lessened; but, notwithstanding this fact I am not aware that it has ever been shown that the high operation is any less fatal in women than in men; certainly the chance of urinary extravasation is as great in the one as in the other, and this has always been accounted the chief danger attending the high operation in both sexes. The vesico-vaginal incision, on the other hand, neither exposes the patient to wounds of the peritoneum nor to the more real danger of urinary infiltrations. There are no vessels exposed to the knife in the vesico-vaginal septum of sufficient size to require a ligature; a stone of the largest dimensions may be removed by this channel; and when, by a subsequent operation, the fistula is closed, incontinence of urine is not likely to be entailed, as is generally the case after other sub-pubic sections, and as often happens when even dilatation of the urethra has been practised.

There is one additional reason why, in certain cases, a cutting operation, and especially this which we are now considering, might properly receive the preference. When the bladder is suffering under chronic cystitis, due to the prolonged presence of a calculus, experience has shown that a free incision, paralyzing for a while its muscular tissue, and permitting the escape of the urine without any contractile effort, constitutes our most reliable therapeutical resort, the inflammation usually subsiding rapidly after the incision is made. This observation has been especially made by Drs. Emmet and Bozeman, of this city, whose large experience in vesico-vaginal operations entitles their opinions to respect. I have also myself had occasion to notice the same fact.

Dr. Emmet describes his mode of operating per vaginam as follows: —A sound, somewhat abruptly curved an inch and a half from its extremity, is introduced through the urethra, and held by an assistant with its extremity firmly pressed against the base of the bladder a little beyond the neck, and exactly in the median line. He then seizes with a tenaculum the vaginal wall where the sound causes it to project, and with a pair of scissors opens the bladder and permits the sound to escape into the vagina. One blade of the scissors is now introduced into the bladder, guided by the sound, and the vesico-vaginal wall is opened upwards, to the extent necessary for the extraction of the stone.

Dr. Emmet states that he has frequently closed the opening immediately after removing the calculus; while in other cases he has permitted the vesico-vaginal communication to continue several months, in order to insure the relief of the cystitis: and he further remarks, that the tendency of the wound to close spontaneously is so great that he has frequently found it united through its entire length within a few days, when no sutures had been employed.

Among those who have recently practised this operation successfully —no incontinence of urine having resulted—may be mentioned Drs. Sims, Emmet, and Robert Nelson, of New York; Dr. Tewksbury, of New Hampshire; and Drs. Lane, Lyon and Aveling, of Great Britain. (Aveling has collected reports of 35 operations made by this method.) Mr. Paget operated in 1859 upon a child three and a half years old· but the small size of the vagina rendered the application of sutures impossible, and incontinence of urine resulted. Mr. Fergusson, also, operated in 1862 upon a child nine years old, using but one suture, and a fistulous opening remained. In the case alluded to above as a successful operation by Dr. Tewksbury, the patient was seven years old; and although the vaginal wound, having been closed at once by sutures, united speedily, other calculi were soon formed; these were subsequently removed by Dr. Bonney, after crushing them with a small pair of forceps, and since then the calculi have not been re-formed. The proper inference would seem to be, therefore, that in this case the forceps might in the first instance have been substituted for the knife, and especially as the original stone was only of the size of a pigeon's egg, and was so soft that it was crushed in the attempt to seize and remove it.

MALFORMATIONS OF THE MALE ORGANS OF GENERATION.

Failures of Development.—The testes, vasa deferentia, and vesiculæ seminales may all be more or less imperfectly developed; or either one of these organs may have suffered arrest of development while the others have not. Thus, for example, the testes may be of normal size while the seminal canals and the vesiculæ are almost wholly absent, and the subject is necessarily impotent; or the vesiculæ and the vasa deferentia may be perfect, while the testes are absent, the person preserving his virility, but being at the same time sterile.

Non-descent of Testes.—Ordinarily the testes descend a short time prior to birth; but quite frequently the descent is delayed a few weeks or months—more rarely until the 15th or 20th year—and in a few examples the testes never descend. Reference has been made elsewhere to the liability of hernia to which those persons are exposed whose testes descend late in life. As a rule, retained testes are immature, atrophied, or degenerated, and the virile function is feeble; exceptions, however, are quite frequent, and no anxiety need be felt upon this point if one testis has already descended and possesses its normal size. Retained testes are liable to acute inflammation, and especially as a consequence of gonorrhœa.

Testicle in the Perineum.—M. Ricord, Humphrey, Erichsen, Zeis, and others, have mentioned examples in which one of the testes has been found in the perineum, between the thigh and the scrotum, where it has been mistaken for a hernia, or, when inflamed, for an abscess.

Testicle in the Crural Canal.—The testicle has been found in the crural canal In other cases it has escaped from the canal and been deflected upwards upon Poupart's ligament, pursuing the course and presenting the appearance of a femoral hernia.

Retroversion of the Testicle.—I have several times met with examples in which the testicle was half turned upon its axis, so that the vas deferens and the epididymis were in front. Other writers have noticed similar anomalies in the relative position of these organs.

SURGICAL DISEASES OF THE MALE ORGANS OF GENERATION.

Inflammation of the Testicle and of the Epididymis.—Inflammation of the testicle is usually denominated *orchitis*, and inflammation of the epididymis, *epididymitis*. Inflammation of these organs may occur separately or conjointly. It may be acute or chronic; traumatic or spontaneous; syphilitic, gonorrhœal, or tuberculous; or it may occur as a metastasis of mumps.

Except, perhaps, in tuberculous or syphilitic cases, these inflammations seldom terminate in suppuration; but they very often leave chronic enlargements and indurations, which continue for a number of years, and then terminate in a gradual atrophy and degeneration, with loss of function.

In the section devoted to "gonorrhœa" I have sufficiently indicated the symptoms and treatment of inflammation of the testis and epididymis, which inflammations do not differ essentially, whatever may be the special constitutional or local cause: at least it will be proper to say, that no important differences are observed in the acute and subacute forms. The reader is therefore referred to the section mentioned, for the further consideration of this subject.

Abscess of the Testicle.—It has already been affirmed that this result is unusual as a consequence of pure traumatic or indiopathic inflammation. Most of the cases which I have seen have occurred in strumous, tuberculous, or syphilitic patients, and usually when the inflammation was of a low and chronic character. The pus, which may form either in the substance of the testis or in the epididymis, gradually makes its way through the enclosing tissues and generally presents itself in front, where the abscess may be opened and the pus evacuated, to the great relief of the patient. It is said that small abscesses in the interior of the testes, having a tuberculous origin, sometimes disappear spontaneously, the contents becoming changed into a putty-like or calcareous substance.

In a few fortunate examples, the abscess having been evacuated, the canal closes permanently in the course of a few weeks; or, after having opened and closed several successive times, a cure is effected, although the function of the organ is seldom restored. More frequently, however, the sinuses persist for a great length of time, particularly if the patient is of a strumous habit, or is in poor health from any cause.

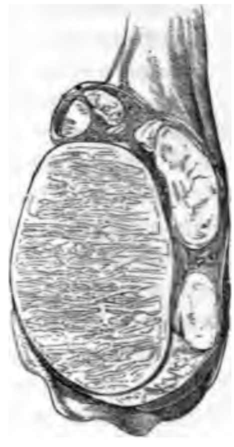
Treatment of the Sinus.—First in importance is the improvement of the general condition, by such means as may seem appropriate. As local remedies, we have found useful frequent injections of mild stimulating fluids, such as the carbolic acid in the proportion of one grain to the ounce of water, or the sulphate of zinc in the same proportions; but the most reliable expedient is the introduction of a seton of oakum, of silk, or of flexible rubber, which shall maintain a free and unobstructed discharge of the pus at opposite points. This must be continued several weeks, or until all the side channels are closed, and when removed the same injections before recommended must be employed until the cure is effected.

Hernia of the Testicle.—Where the fistulous opening has continued some time we occasionally find what appears to be a fungus, or simple granulations protruding from the aperture, and finally attaining the size of a goose-egg, although it is usually considerably smaller. The surface of this mass is generally covered with lymph at certain points, while at others it is undergoing ulceration or perhaps sphacelation. The integument and testicular coverings are usually somewhat constricted upon the hernia, and the mass is made to assume a pyriform or globular shape, with a neck corresponding to the aperture from which it emerges. Mr. Lawrence has shown that this protrusion is the swollen and indurated structure of the testicle, thrust out through the tunics, and not, as has generally been supposed, an entirely new product. Nevertheless, after a time, a large portion of the mass is found to be composed of the products of inflammation.

Treatment.—When such protrusions are of small size, rest in the recumbent posture, moderate compression, the employment of astringent or of mercurial ointments, and especially the use of carbolic acid, will sometimes effect a gradual subsidence or retrocession of the hernia and a complete cure; or the inclusion and healing may be facilitated by incision and sliding of the integument. When, however, the protruding mass is large, and has continued a long time, in spite of appropriate treatment, extirpation may become necessary; indeed, although we might properly encourage a hope that a cure could be ultimately effected, the time necessarily occupied to accomplish this, when a large portion of the testis has escaped, is generally so great that most patients, if fully informed as to their prospects and of the nature of the case, will prefer excision. The organ can probably never again perform its function, and we have generally, under these latter circumstances, recommended and practised castration.

Strumous Enlargement of the Testicle.—Strumous or tuberculous orchitis has been mentioned as one form of inflammation of this organ. The slow, chronic enlargement which is now to be considered is not usually preceded or accompanied with any of the ordinary signs of inflammation, although at any period of its progress inflammation may supervene as a complication. It occurs most frequently between the fifteenth and twenty-fifth years of life, but is occasionally met with in infancy and in old age.

Fig. 443.



Tuberculous Testicle.

In both acute and chronic orchitis the areolar tissue and the fibrous septa are the especial seats of the pathological lesions; but in strumous enlargement the tubuli, either of the testes or of the epididymis, are themselves in most cases primarily and chiefly affected; their channels becoming first obstructed and engorged with strumous or tuberculous deposits; and, subsequently, in some cases, the coats of the tubuli, the fibrous septa, and the whole interior of these organs are found also infiltrated with similar deposits, so that nothing remains of the original structure but the investing tunics. Not unfrequently the induration extends upwards along the cord, and both the vesiculæ seminales and the prostate may become involved; and, finally, both testes may be simultaneously or consecutively affected.

It is in these examples especially that chronic abscesses and obstinate fistulæ are apt to occur; and from the orifices of these fistulæ, more than from any others, those masses of tubuli, constituting a hernia testis, are apt to protrude which were considered in the preceding section.

Diagnosis.—The differential diagnosis in scrofulous enlargement of the testes is based chiefly upon the condition of the general system, and upon a physical exploration of the chest. As local differential signs, may be mentioned the slow and insidious progress of the induration, commencing usually in the epididymis; the absence of severe pain, and of palpable inflammation; the hard and sometimes nodulated feel; the greater tendency to suppuration; the intractable character of the fistulæ, and the disposition to hernial protrusions. The *syphilitic enlargement*, in many respects, bears a very close resemblance to the scrofulous; but we have found it less prone to suppurate, and the history of the patient will generally render an otherwise doubtful diagnosis complete.

Scirrhus of the testicle is exceedingly rare. It has been seen only in advanced life; it is painful; the induration is more intense than in any other form of testicular enlargement, and it never suppurates. (See Cancer of the Testicle.)

Treatment of Strumous Enlargement of the Testicle.—The constitutional treatment must be sustaining, and in all respects such as is understood to be appropriate in strumous and tuberculous patients. If any local applications are made with a view of dispersing the induration, the iodide of potassium ointment would theoretically claim the preference; but clinical experience has not convinced me that it possesses any efficacy in that regard.

The fact that the disease is of a strumous character constitutes, in itself, no valid objection to castration, only that the removal of the testis does not arrest the progress of the disease in the general system, and furnishes no guarantee that it will not in a like manner invade the other testis; but that the removal of an ulcerated or fungous testicle, which is a constant source of annoyance and drain upon the system, is proper, and, indeed, serviceable, whether the patient is or is not strumous, seems not to admit of a doubt, any more than that it is proper and serviceable to remove under the same circumstances a diseased joint.

Cystic Disease of the Testicle. Syn., Cystic Sarcocele; Hydatid Testis, of Sir A. Cooper.—This form of disease of the testicle is exceedingly rare. It has been observed most often after the twentieth year, although it may occur at any period of life. The testis acquires a greater size than when enlarged by strumous deposits; it is not so hard, but has a somewhat elastic feel, and it is, in most cases, neither painful nor tender.

From hydrocele it may generally be distinguished by its lack of transparency; by the somewhat irregular feel of the surface, occasioned by the existence of numerous separate cysts; and by the absence of that peculiar pear-shape which distinguishes most hydroceles. The veins of the cord are usually enlarged when the disease has made much progress. Examined by the exploring needle or with a fine trocar, a small quantity of clear fluid may escape, indicating that a single cyst has been emptied. From encephaloid it will be distinguished by its less rapid growth, and by the absence of other signs of malignancy.

The structure of these growths resembles the cystic sarcoma of the mammary gland, being formed of separate cysts, which vary in size and form, containing a thin, pale fluid, but which is sometimes viscid and colored. The cysts are also frequently occupied by outgrowths from their interior walls, the same as have been observed in mammary and ovarian cysts. They possess also a variable amount of fibrous tissue.

Treatment.—Castration is the only remedy. Nor has this always proved successful, inasmuch as, although the disease is generally regarded as non-malignant, in exceptional cases it has assumed a malignant form, and especially when it has returned after extirpation. Sometimes the wound heals kindly, but the patient soon dies from encephaloid disease, developed in the lungs or other viscera.

Cystic Enchondroma.—Not unfrequently the cystic tumor of the testicle is associated with enchondroma; the cartilage, existing in the form of nodules, which appear to grow from the interior of the cysts; but it is uncertain whether these nodules have not originated in the intermediate structures, and by their growth and pressure subsequently obtruded themselves upon the cavities formed by the cysts. Some of these enchondromatous formations become infiltrated with earthy matter, and in certain old tumors of this class the calcifying process has been found to have made considerable progress.

Treatment.—The same practice must be adopted in this form of the cystic tumor as in the preceding.

Dermoid Cysts.—Cysts are occasionally found in the testes, the lining membranes of which possess a tegumentary character, being furnished with hair and sebaceous follicles, and from the interior surface of which short hairs are seen to be growing. The contents of these cysts are sebaceous matter, mingled with scales which have undergone more or less of the oily degeneration, earthy materials, hair, and sometimes irregularly-formed teeth and bones. These cystic formations are generally, if not always, congenital. They are usually developed in the substance of the testicle, but sometimes they are found lying wholly external to the tunica albuginea. Their growth is usually slow, and corresponds pretty nearly to the growth of the body. When the enclosing tunics become inflamed, from any cause, they may increase rapidly in size, suppuration may ensue, and the contents be thus discharged spontaneously.

The question of the manner in which these tumors and their contents are formed cannot here be discussed. It will be sufficient to say that two modes of explanation have been offered, namely, involution of integument or "fœtal inclusion;" and deviation or abnormity of development, by virtue of which certain tissues assume unusual attributes or powers of construction.

Treatment.—Incision, with evacuation of the cyst, might effect a cure; but inasmuch as, with very rare exceptions, the testicle is involved, castration must generally be preferred.

Hydatids.—The term "hydatid cyst," applied by Sir A. Cooper to encysted sarcocele, it will be understood by the intelligent student, must be regarded as a misnomer. In tropical climates, however, a true hydatid cyst is occasionally found in this organ, occupied by the filaria medinensis, or guinea-worm.

Cancer of the Testicle.

True scirrhus or hard cancer is of such rare occurrence in this organ that many experienced surgeons and pathologists have expressed a doubt whether it ever occurs. Rokitansky, however, affirms that all the varieties of cancer are met with occasionally in the testes. Melanotic deposits have been occasionally seen in connection with cancer of the testicle. The colloid variety is rare, also, yet I have met with this form in children several times; but in a large majority of cases cancer of the testicle belongs either to the encephaloid or fungoid varieties.

Scirrhus of the Testicle, like scirrhus occurring elsewhere, is seldom or never seen except in advanced life; its progress is slow and insidious, but generally accompanied with pain; the epididymis and vas deferens are early involved; the tumor rarely attains a great size, but it is exceedingly hard and nodulated, and in proportion to its bulk is heavier than any other form of tumor in this organ. The concurrence of a general cancerous cachexy and exploration will serve to complete the diagnosis.

Colloid Cancer of the Testicle presents very much the same general history as the encephaloid and fungoid, which are presently to be described; but I have seen it only in childhood and infancy; and in these cases it has been sometimes found difficult to distinguish it from a hydrocele, on account of the uniform oval shape which it is apt to assume, its great and uniform elasticity, and its occasional translucency. The colloid testicle is, however, in most cases, less translucent than an infantile hydrocele; it is usually more nearly oval and less pyriform in shape; it grows with greater rapidity, and soon exceeds in size the dimensions usually attained by the hydrocele. In most cases, also, the general health is early impaired. Exploration, with or without a microscopical examination, will always complete the diagnosis.

Encephaloid of the Testicle occurs at all periods of life; it is usually rapid in its growth, and in several instances I have seen it attain the size of a cocoa-nut in the course of a few months. The surface is generally somewhat irregularly elevated; it is elastic or spongy to the feel; and its progress is unaccompanied with the signs of inflammation. If allowed to remain, the scrotum eventually ulcerates and gives way to the pressure of the morbid growth, and a fungoid mass protrudes.

Differing in no essential point from encephaloid as it presents itself in other organs and structures, a further description of this malady as it appears when it invades the testicle is unnecessary.

Treatment.—Excision is practised sometimes, and with propriety, in all the varieties of cancer of the testes, when the disease has not involved the cord; not indeed with the expectation of effecting a cure of what experience has proven to be an almost inevitably fatal malady, but solely as a palliative, and to defer for a time the fatal event.

Castration.

The parts having been previously well shaven, an incision is made from a point opposite the external abdominal ring to the most depending portion of the sac. In case the testis is much enlarged, and especially when the operation is made for the removal of a malignant disease, it will be advisable to make double elliptical incisions, including a considerable portion of the scrotum; taking care, however, to leave sufficient integument to render it certain that the lips of the wound may be easily approximated. By carrying the incisions to the bottom of the scrotum, and by ablation of superfluous integument, the subsequent drainage will be more complete, and the cure will not be retarded by pouches containing pus.

Before the introduction of anæsthetics, it was my usual practice to diminish the pain of the operation by dividing the cord before dissecting out the testis; and if for any reason the operation should have to be performed while complete consciousness remains, I shall advise the same procedure. For this purpose the cord must be freely exposed, divided, and its arteries secured, as the second step of the operation. When, however, the patient is insensible, it will be found more convenient, after making the first incisions, to expose and enucleate the testicle, avoiding carefully the septum which separates the testes, and then to carry the dissection upwards until the point is reached where it is thought proper to divide the cord. This must be above all traces of disease, if possible. When the cord is divided it retracts, in some cases, two or three inches, and, withdrawing itself within the inguinal canal, it may become necessary to lay open this canal in order to secure the bleeding vessels. This accident has happened pretty often, and surgeons have devised various expedients for its avoidance. When no portion of the cord is involved in the disease, and it can be severed safely close to the testis, it will be generally sufficient to hold the cord between the thumb and finger; and, having divided it below the point where it is held, to retain it in view until the spermatic and deferent arteries are tied; but in case it has to be divided higher, and especially when the cord is drawn out of the ring by a tumor of great size, one of two expedients must be adopted,—either the cord must be tied in mass with a strong ligature, or it must be transfixed with a needle armed with a similar ligature and held in place until the cord is divided and the arteries are ligated. Mr. Erichsen prefers the ligature in mass in all cases, and thinks no inconvenience or injury is likely to result from this method. Most surgeons think differently; and for myself I am obliged to say that in the only case in which the ligature was applied to the entire cord under my observation, the patient suffered great pain as a consequence; and my opinion is that it is much better in such cases to transfix the cord with the ligature, which places it wholly under control; and, in order to provide against the possible occurrence of secondary bleeding, to permit this to remain in the wound several days, as a ligature of reserve.

The bleeding from the vessels of the scrotum is also quite as likely to prove troublesome, within the next ten or twelve hours, as that which may occur from the vessels of the cord: indeed, according to my experience, it is much more so. The arteries of the scrotum are numerous, and the formation of coagula is perhaps prevented, in some measure, by the constant vermicular motion occasioned by the remaining fibres of the cremaster and dartos muscles; but the chief source of these troublesome secondary hæmorrhages is the retraction of the vessels into the exceedingly loose areolar tissue where thrombi enclose their orifices, which, as has elsewhere been explained, encourage the bleeding. Too much pains cannot, therefore, be taken in securing every vessel which bleeds. Whenever a small clot of blood is seen entangled in the meshes of the cellular tissue, the sponge must be applied, rudely if necessary, for its removal, and the bleeding vessel must be tied. The wound may then be closed by sutures, and the parts covered with cloths moistened with tepid water; the remnant of the scrotum being kept well supported by a small pillow placed between the thighs.

Hydrocele, R. C.

Of hydrocele there are several varieties, namely, hydrocele of the tunica vaginalis testis, occurring in the adult; hydrocele of the same tunic occurring in the infant, or infantile hydrocele; hydrocele of the cord, and encysted hydrocele.

Hydrocele of the Tunica Vaginalis Testis in the Adult.—A dropsy of the tunica vaginalis testis may occur at any period of life. In old age it is probably sometimes due to certain changes in the general system or in the serous surfaces incident to advancing years; but a large majority of the cases occurring in youth and middle life may be traced to some degree of hyperæmia induced by a local injury, a gonorrhœal metastasis, or to excessive venery. Not unfrequently the testis is found also moderately enlarged and preternaturally sensitive. It is seldom that the effusion takes place simultaneously in both sacs; and one sac is about equally liable to the malady as the other.

A hydrocele is usually pyriform in shape, with its base directed downwards. In perhaps one case out of every twenty or thirty I have found it cylindrical, the upper portion of the sac, with probably a portion of the tunic enclosing the cord, yielding to the pressure of the contained fluid in an equal degree with the lower portion; or it may become constricted and assume the shape of an hour-glass. Its surface is smooth and uniform, and on pressure it gives a distinct sensation of elasticity, and of fluid contained in a single cavity. It is not usually tender, painful, or discolored. A hydrocele seldom contains more than eight or ten ounces of fluid, but occasionally old hydroceles attain an enormous size and are found to contain several pints, and it is said that Gibbon, the historian, had a hydrocele which contained six quarts. The testis may generally be distinctly felt in the lower and back part of the tumor, and it will be especially recognized by the peculiar pain which the patient suffers when that organ is touched. The surgeon must not omit to ascertain the actual position of the testis before he undertakes an operation, inasmuch as its position is in certain abnormities, or as a consequence of a diseased and contracted condition of the tunic, in front of the tunica vaginalis.

Recent hydroceles, and especially infantile, are generally translucent; the translucency can be best observed by taking the patient into a dark room, and looking across one side of the tumor toward a lighted candle held below the buttocks. In certain old hydroceles the thickening of the sac, and the change in color, consistence, and chemical character of the contents may render the tumor opaque. If the inexperienced surgeon finds any difficulty now in distinguishing it from an inguinal hernia become scrotal, he will be aided in his farther diagnosis by its history. A hernia has descended, probably very gradually, from above; a hydrocele commences from below. The enlargement connected with a hernia extends within the ring, and, if the hernia occupies the scrotum, it is of the shape sometimes of an hour-glass, but the constricted portion is higher up than in the hour-glass constriction of hydrocele; or, if it has not descended so far, its base is directed upward. It must be remembered also, that a hernia which cannot be returned into the cavity of the abdomen must speedily give rise to symptoms of a sufficiently grave and distinctive character to render its diagnosis absolute. The exploring needle can only be employed with safety as a means of diagnosis, when the question of the existence of a hernia has been satisfactorily excluded. Occasionally a hydrocele and a hernia coexist. I have met with several of these examples.

The contents of a hydrocele are in most cases a thin straw-colored serum, which may be regarded as the result of an increased secretion and accumulation of that fluid which naturally moistens the interior surface of the sac. Sometimes it contains fibrine and other well-declared products of inflammation; there may be present, also, blood-globules, fatty matter, cholesterine, or a substance resembling milk. In a case in which I recently performed the radical operation by the long incision, a smooth round ball escaped of the size of a small marble, quite solid, and composed chiefly of fibrine with a small amount of cholesterine.

I am not aware that any plan of constitutional, or of local treatment other than a surgical operation, has ever succeeded in the dispersion of a hydrocele; although it must be admitted that they sometimes disappear spontaneously. The surgical treatment is of two kinds, palliative and radical.

Palliative Operation for Hydrocele.—The palliative treatment consists in the removal of the fluid by tapping. It is resorted to whenever delay in the performance of a radical operation is considered desirable; and by many surgeons, as a preliminary to the radical operation, in order that the precise condition of the testis may be determined before adopting a procedure which may be thought to be more grave and more liable to serious accidents.

Tapping as a palliative operation may be performed with an ordinary trocar and canula, or with a narrow sharp-pointed bistoury. I have generally employed the latter instrument. The scrotum being grasped with the left hand, in such a manner as to increase the tension of the integument over the front of the tumor, and the situation of the testis having been ascertained to be normal, the knife is introduced into the anterior and lower portion of the sac—but not quite so low as its base—with its point directed a little upward. When the point of the instrument has fairly entered the sac, which may be known by the escape of fluid, it is withdrawn rather slowly, enlarging the tegumentary incision a little as it emerges, so as to avoid the escape of the fluid into the subcutaneous areolar tissue.

I have once tapped a hydrocele in an old man which resulted in a radical cure, as the sac never became refilled; but in nearly all cases the fluid gradually accumulates again, and the inconvenience is, after the lapse of a few months, as great as ever.

Radical Operations for Hydrocele.—Clinical experience has demonstrated that there are two modes in which a radical cure of a hydrocele may be accomplished. By one method, the fluid having been evacuated, the reaccumulation is prevented by a restoration of the serous surface to its normal condition, so that hereafter the secretion is not in excess of the absorption; and the result thus obtained is usually denominated a "change of action." This would seem to be the only proper method, if it can be shown to be reliable, since it is a cure without mutilation. The other method consists in obliterating the sac completely, after the fluid has been evacuated.

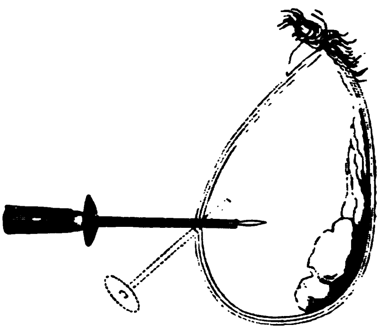
It may not be possible to arrange all of the various procedures under these two heads, since the same procedure appears to accomplish its results sometimes in the one way and sometimes in the other; but the treatment by injections of iodine may be considered as therapeutically typical of the first, and by the long incision as typical of the second.

Operation for Hydrocele by Injection of Iodine.—According to Erichsen, this method was introduced by Sir J. R. Martin, of Calcutta, although it is claimed by M. Velpeau for himself, who published his first observations in 1836. The serum being withdrawn by a trocar and canula, from one to two drachms of the pure tincture of iodine are thrown into the sac by the aid of a syringe fitted to the canula. The iodine is retained a few minutes, longer or shorter, according to the amount of pain which it may occasion, and then allowed to escape. Mr. Syme and some others, who have adopted this practice, have preferred to leave the tincture in the sac, with the expectation that it will be subsequently disposed of by the absorbents.

Sulphate of zinc, in the proportion of two grains to the drachm of water, has also been employed in the same manner; and Mr. Davey, of Ceylon, attributes his remarkable success in the use of this agent to his practice of kneading the scrotum, a minute or two after the injection is made, to bring the zinc forcibly in contact with the whole surface of the membrane. I have seen brandy and water, port wine, and, in the case of an old hydrocele, the spirits of turpentine employed in the same manner. Indeed it would seem that any agent which can cause irritation, or a moderate inflammation in the sac, is competent sometimes to effect a cure.

I have selected the injections of the tincture of iodine to illustrate the mode of cure by a "change of action;" but it is probable that injections of the sulphate of zinc, of the persulphate of iron, etc., occasionally, but not so often as the tincture of iodine, effect their cures upon the same principle. M. Hutin examined sixteen cases in which hydroceles had been cured by various methods, and he found eight in which the sac was wholly obliterated by adhesions, four with partial obliteration of the sac, and, in the remaining four, the sac retained its normal size and appearance.

Fig. 444.



Tapping with Trocar and Canula.

In the absence of experience, it would seem proper to infer that any method of injection which was liable to produce adhesive inflammation, in twelve out of sixteen experiments, would also be liable to cause suppurative inflammation, in a considerable proportion of cases; and, on the other hand, that a method which effected its cures in the remaining four cases by the production of a lower grade of excitement or of inflammation, which was only sufficient to cause a resolution of the diseased condition upon which the existence of the hydrocele depended, ought pretty frequently to fail; but the experience of some surgeons is in direct conflict with these theoretical inferences. Sir J. R. Martin estimates his failures under the iodine treatment as only one in a hundred, and M. Velpeau rates them in his experience at only three per cent. Some other surgeons have claimed an equal success.' On the other hand, Mr. Erichsen, although convinced that iodine injections ought in general to be preferred to all other methods—and in this opinion he says he is sustained by most English surgeons—admits that the ratio of success has probably been exaggerated; but for myself I am obliged to go a great deal farther, and to say that the failures by iodine injections are quite equal to the successes. In the early part of my practice, and for many years, I made no other radical operation for hydrocele; and most or all of my contemporaries in this country, under the influence of the great name of Velpeau, did the same. My experience, therefore, entitles me to speak in some measure authoritatively. When port-wine, brandy, and turpentine have been used, I have twice seen sloughing of the entire scrotum, and in several instances suppuration of the sac. With the tincture of iodine, sloughing has never occurred under my observation, but suppuration has been an occasional result. In a considerable proportion of cases the first operation has proved an entire failure, rendering it necessary in some cases to repeat the operation several times; and of those remaining permanently under my observation, and supposed at first to have been cured, not a few have returned to me, after the lapse of two or three years, with the hydrocele as large as ever. The conclusion to which this experience has gradually conducted me is that this operation, not wholly free from danger, is altogether too unreliable to merit any further trial, and I have for many years abandoned it altogether.

Operation for Hydrocele by the Long Incision.—In the New York Medical Gazette for February 29, 1868, I published the result of the operations made by myself for hydrocele by what I have termed the "long incision." Since that date I have repeated the same operation many times, and thus far not a single failure or accident has been observed. My method is as follows: with an ordinary scalpel the integument is divided on the anterior surface of the tumor to the extent of not less than three or four inches; this is followed by a second incision through the tunica vaginalis of at least two or three inches in length. The contents of the sac having escaped, and the bleeding vessels having been secured, a long, narrow piece of lint is placed between the lips of the wound, partly within the sac, and the whole is covered by a slippery-elm poultice; the patient being directed to remain in bed upon his back, with the scrotum well supported by a small pillow placed between his thighs. The lint is generally removed on the fifth or sixth day; but the poultices are continued a week or ten days, and after their final removal the patient is permitted to sit up, with dressings only of simple cerate. The great length given to the incision is rendered necessary by the contraction of the sac which immediately ensues upon its evacuation, in consequence of which an opening three inches in length becomes reduced to one inch or perhaps less. On the fourth or fifth day following the operation, there is sometimes a considerable inflammation and swelling of the scrotum, and often some swelling of the testis and cord, but if the poultices are continued this soon subsides; and in the majority of cases it is no greater than I have often seen follow injections of iodine.

The above-described operation, by long incision and the subsequent introduction of tents, was practised by surgeons from a very early date; but, like many other valuable surgical expedients, it has vacillated from time to time in public favor. Dr. N. Smith, of New Haven, many years ago adopted a similar method, but the incision which he made in the tunica vaginalis was only three-quarters of an inch in length.[1] Dupuytren employed a piece of a catheter as a tent, in order to secure effective drainage, and Dr. N. R. Smith, of Baltimore, attached a small piece of a sponge to the end of the catheter to prevent it from falling out of the wound. A piece of a drainage tube might answer the purpose even better than the piece of catheter.

In addition to the guarantee which the long incision can give of complete success, it may be said in its behalf, as compared with injections, that by it we avoid the danger of wounding the testicle; if a congenital hernia happens to occupy the sac, and has not been recognized, its presence will be detected in time to prevent its being cut; if fibrous, cartilaginous, or calcareous bodies occupy the sac, this method alone can effect their removal or promise a cure; there is no danger of causing gangrene, as has happened so often from the escape of the injected fluids into the areolar tissue; no evils from imprisoned pus are to be apprehended; and the surgeon need not be deterred by the concurrence of the hydrocele with an enlargement of the testicle.

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[1] *Medical and Surgical Memoirs*, by Nathan Smith, M.D., late Prof. Surgery, etc., in Yale College, with Addenda by N. R. Smith, M.D., Prof. Surgery in the University of Baltimore. 1831, p. 183.

Operations for Hydrocele by Setons.—The use of a seton for the radical cure of a hydrocele is supposed to have been recommended by Galen. It was practised by Paré, Marini, Pott, and by many other excellent surgeons at different periods, and is still preferred by some of our most experienced operators. Dr. Gross prefers it to all others on account of its "simplicity, freedom from danger, and never-failing certainty." His mode of procedure is as follows: The sac is evacuated in the usual manner with a trocar and canula. The trocar is then reintroduced, and with the canula brought out through the upper portion of the sac. The trocar being again withdrawn, a seton is carried through the canula by the aid of a probe furnished with an eye, the canula is removed, and the seton left in place. The seton is permitted to remain twenty-four or forty-eight hours, or until considerable swelling has taken place.

I cannot myself regard the seton as either so safe or so certain as the long incision. I have seen it fail; and in one instance, where a metallic seton was employed by myself, in the person of a distinguished artist, who had insisted upon this mode of operating, the sac became filled with pus, which had to be removed by incision; inflammation of the absorbents ensued, and abscesses formed in the corresponding groin and in the axilla, his final recovery being delayed several months.

Other Operations for Hydrocele.—Electro-puncture, acupuncture, the cautery, excision of small portions of the lining membrane, and compression by gum-elastic bags, are expedients which have occasionally been resorted to, but not with a sufficient degree of success to secure for them the general approbation of surgeons. The treatment by electro-puncture, or by electricity without puncture, is the most recent of the several methods just enumerated, and it is said by certain late French writers to dissipate the hydrocele speedily. The only case in which it has been tried, within my knowledge, both the negative and positive poles being introduced within the sac, was a complete failure.

Infantile Hydrocele. Syn., Hydrocele Infantilis, R. C.—Hydrocele is a pretty frequent occurrence with infants who are only a few weeks or a few months old. It is presented under two conditions: in one of which the communication between the tunica vaginalis and the cavity of the peritoneum is not closed; a congenital imperfection, to which allusion has already been made in the chapter on hernia. This imperfection sometimes continues through adult life. In the other case, which has seemed to me much the most frequent, the canal of communication is closed, although it may not be obliterated in its entire length.

The causes of infantile hydrocele are imperfectly understood. It is probably not often, as in adults, due to any inflammatory action in the testes themselves, but perhaps to some injury suffered by the scrotum and the tunica vaginalis during parturition, or to the irritation caused by acrid fæces and urine. By some writers those examples in which the peritoneal process remains open have been supposed to be the results of an increased secretion in the peritoneal cavity, and not to be dependent in any degree upon disease of the tunica vaginalis testis.

Symptoms of Infantile Hydrocele.—Infantile hydrocele differs from the hydrocele of adults chiefly in its greater translucency, and by its assuming less uniformly a pyriform shape. When the canal is only closed in its upper half or third, the form of the hydrocele is generally nearly cylindrical; and the same is usually the fact when it remains completely patulous. In the latter case, also, when pressure is made upon the sac for a considerable length of time, a portion of the contents can generally be made to recede into the cavity of the abdomen. In some cases, however, although the communication exists, the opening is too small to allow the fluid to pass in any appreciable quantity.

Treatment of Infantile Hydrocele.—A large proportion of these cases get well spontaneously after the lapse of a few weeks or months; and I have known them to remain two or three years, and then disappear without surgical interference. Dilute tincture of iodine, the iodine ointment, and other discutients, applied externally, have been credited with cures, although it might be very difficult to show in most of these cases that the cures were not spontaneous. In case applications of this character are made, the surgeon must bear in mind the exceeding delicacy and sensibility of the scrotum in children and infants. Violent inflammation, swelling, vesication, and even sloughing have been caused by the injudicious application of stimulants and vesicants to these parts, in several cases that have come under my observation.

Repeated punctures with an exploring needle, followed by moderate pressure made by the hand, so as to force the contents of the sac into the subcutaneous areolar tissue, has been recommended; but my usual practice is not to interfere with these cases in any manner, unless they become so large as to prove quite troublesome, until sufficient time has elapsed to render a spontaneous cure improbable; and when interference is determined upon I open the sac with a narrow bistoury and allow all the fluid to escape at once. A single tapping, made in this manner, generally effects a cure; and, if it does not, the same operation may be repeated; but under no circumstances ought either of the so-called "radical" operations be made upon infants, and rarely upon children under sixteen years of age.

Hydrocele of the Cord.—Dissections have shown that the peritoneal process is not completely obliterated in very many persons during the whole period of their lives, a small portion remaining patulous at one or another point of the canal. In these sacculi of the tunica vaginalis propria funiculi occur those tumors called hydroceles of the cord. It must be observed, however, that cysts, bearing an exact resemblance to hydroceles of the cord, are occasionally formed in the areolar or other tissues outside of the peritoneal process. When a large number of the cells of the areolar tissue, surrounding the cord, are involved, constituting a variety of "adventitious, multilocular, serous cysts," it is called "*diffused hydrocele of the cord.*" A hydrocele of the cord may be recognized as an oblong, elastic, and generally translucent tumor situated in the course of the cord; and which, according to its size or situation, may or may not extend within the inguinal canal. It contains, in most cases, a fluid precisely analogous to that found in hydroceles of the tunica vaginalis testis.

Treatment of Hydrocele of the Cord.—A free incision of the sac, sufficient to insure a thorough evacuation of its contents, the introduction of a narrow piece of tape to serve as a tent, poultices and rest in the horizontal posture, constitute the only treatment which I have hitherto seen fit to adopt in the few examples of hydrocele of the cord which have come under my notice, and this has proved to be safe and efficacious; but inasmuch as they often occasion little or no inconvenience, and are sometimes known to disappear spontaneously, it will be prudent to defer operating until the necessity may seem to be urgent. Hygromata forming outside of the cord, or *diffused hydroceles*, may be treated in the same manner as hydroceles of the cord.

Encysted Hydrocele. Syn., Hydrocele Cystica, R. C.—This term is applied to certain cysts containing fluid which originate in the tissues adjacent to the testes, but outside of the sac of the tunica vaginalis, some of which occasionally intrude upon this cavity, and in such cases especially bear a very strong resemblance to ordinary hydrocele. Two varieties of these adventitious cysts are observed.

The *first variety*, according to Gosselin, may be found in two-thirds of the testes of persons who have passed the age of forty. They rarely exceed in size a small pea. They may be single, or several may be found connected with the same organ. They are found more frequently upon the epididymis than upon the testis, and in either case they are situated immediately upon the outer surface of the fibrous membrane which envelops these organs. Occasionally they project into the cavity of the tunica vaginalis and become pediculated; and it is thought they may be the sources of those fibrous, cartilaginous, or calcareous bodies which have been found loose in these cavities. They contain a clear fluid, with other microscopical elements, but, unlike the second variety, never spermatozoa. They are seldom observed during life, and probably never demand surgical interference.

Cysts of the *second variety* are more rare, and may attain the size of an ordinary hydrocele. They usually occur upon the epididymis, and n some examples the epididymis is transformed into or lost in a mass f cysts. They may encroach upon the tunica vaginalis so as to occupy ts entire cavity. Their contents are sometimes precisely the same as re found in true hydroceles, but in most examples the contained fluid ore nearly resembles water, or it is of a whitish, milky color. Under hese latter circumstances it contains little or no albumen, but almost lways spermatozoa and other spermatic elements.

Symptoms of Encysted Hydroceles.—The diagnostic symptoms of n encysted hydrocele are often obscure. When, however, an elastic umor is found situated upon the epididymis, at its upper or lower extremity, or upon either side, the existence of this form of adventitious rowth may properly be suspected. When they occupy the tunica aginalis they can only be recognized after the sac is emptied and the luid examined.

Treatment of Encysted Hydrocele.—The treatment is the same as or a true hydrocele. I have lately met with an example of a spermatozoic encysted hydrocele in an old man, situated at the top of the epididymis, which was composed of a number of distinct cells, and which laid open freely, and then by careful dissection removed almost entire.

Hæmatocele, R. C.

Blood is occasionally poured into the cavity of the tunica vaginalis estis as a consequence of the operation of tapping for hydrocele. I ave frequently found a sufficient admixture of blood-corpuscles with he serum, in a second or third tapping, to give to the contents a chocolate color. In one example the sac became distended to its original size n the course of a few minutes after evacuation, furnishing conclusive vidence of the effusion of blood into the cavity previously occupied by he serum. More rarely hæmatocele is the result of a blow upon the crotum; and still more rarely it occurs spontaneously.

Recent hæmatoceles can be distinguished in most cases from hydroceles by their history, and especially by the rapidity of their increase, nd also by their opacity. Old hæmatoceles are also opaque, and sometimes acquire a considerable degree of solidity. The blood may remain n the sac many years without causing any more inconvenience than a ydrocele; or it may, although rarely, lead to suppuration. Like hydroceles, they sometimes attain a very great size.

Treatment.—Absorption of the effused blood seems to have taken lace occasionally, but it has happened so seldom that this fortunate result can hardly be anticipated. In no case, whether the hæmatocele is pontaneous or of traumatic origin, will it be proper to evacuate the ac until after the lapse of a few days or weeks, or until the opportunity as been given for the complete occlusion of the bleeding vessels. In ecent cases absolute rest must be enjoined, and cool applications made ontinuously for several successive days. The patient may then be permitted to go about, with the scrotum well supported by a suspensory bag. If after a month or two no tendency to spontaneous cure is observed, the patient may as well submit at once to an operation for its relief. Tapping with a large trocar and canula has generally been recommended; but unless the hæmatocele is very large and very old, the better plan is to treat it by the long incision, in the same manner that I have advised for hydroceles. In the case of large and old hæmatoceles, the sac is sometimes greatly thickened, and the amount of inflammation and suppuration resulting from exposure of this extensive surface may render the recovery tedious and uncertain. In such cases it will be advisable either to temporize, by tapping, or it may be considered whether it will not be more safe, if a radical cure is proposed, to excise the entire sac with the corresponding testicle.

Varicocele. Syn., Cirsocele, R. C.

Enlargement of the veins of the spermatic cord exists in some degree in about one of every eight or ten male adults; and with rare exceptions, the veins of the left side are alone implicated; indeed the right spermatic veins appear to be no more liable to enlargement than other superficial veins of the lower portion of the body. The most plausible conjecture which has hitherto been offered for the greater frequency of varicocele on the left side, is the anatomical fact that the left spermatic vein empties itself into the left emulgent at a right angle, in consequence of which the returning spermatic current meets with unusual resistance, while the right spermatic vein enters the vena cava ascendens at an acute angle, or nearly in the direction of the upward current of the latter, and consequently meets with no obstruction. It has been suggested that fæcal accumulations in the sigmoid flexure of the colon may have some influence in the production of varicocele. Brinton has also demonstrated the existence of a valve in the right spermatic vein at its entrance into the vena cava, which prevents the regurgitation of blood, while no such provision exists at the emulgent vein on the left side.

Diagnosis.—The feel of a varicocele has been very aptly compared to a bundle of earthworms. From a hernia it is distinguished by the fact that a scrotal hernia, with which alone it is liable to be confounded, descends slowly and gradually from above, while varicose veins are first observed in the most depending portions of the cord or scrotum. Moreover, if the patient rests for a few moments in the recumbent posture, the veins will become emptied, and the enlargement will in some measure disappear, as might happen also if it were a hernia; but if now the finger be placed upon the external ring and the patient be directed to rise, the blood will soon return to the veins; but if it is a hernia, it cannot descend until the finger is removed.

A varicose condition of the spermatic veins, in most cases, causes but little inconvenience beyond a sensation of weight; occasionally, however, they have caused atrophy of the testicle, and in a few instances I have seen varicoceles associated with neuralgia of these organs; and in other cases they continue to enlarge from year to year until eventually they attain a great size.

Treatment.—Generally patients are content with wearing a well-adjusted suspensory bag, made of cotton cloth or silk netting. Beyond this nothing can be done, unless it is determined to resort to a radical operation.

The radical operations which have been devised for the cure of a varicocele are numerous. Celsus and Ætius recommended obliteration of the veins by caustic. Velpeau passed a steel pin behind the veins and then applied a ligature in the manner of the hare-lip suture; Davats used two pins, one of which penetrated the vein longitudinally; Bonnet transfixed the vein transversely with a flexible pin, and then the ends were bent toward each other, but no ligature was applied; Fricke passed a ligature under the vein but did not tie it, leaving it to operate like Physick's fracture seton; Delpech, of Montpellier, substituted a tent for Fricke's thread seton; Reynaud passed a ligature under the vein and tied it over a pledget of lint; Vidal and others have tied the veins by subcutaneous ligatures; Breschet employed compression with pincers; Warren exposed the veins, bisected and tied them; Brodie made subcutaneous bisection, and then employed pressure; and lately it has been proposed to effect a cure by the coagulation of the blood caused by a current of electricity—that is, by electrolysis.

I have made this rapid survey of the leading methods in order that the reader may understand that no plan which ingenuity can devise has probably been left untried. But a careful study of the literature of this subject will show that nearly all, perhaps all of these, and of various other plans of obliterating varicose spermatic veins, have either proved inefficient, or they have from time to time proved fatal in consequence of the supervention of phlebitis; and each in its turn has by one surgeon or another been condemned as useless or hazardous. And what reason can be assigned why one method should prove less dangerous than another, so long as they all alike accomplish the obliteration of the veins by the same process, namely, by inducing in a greater or less degree inflammation? For notwithstanding it is affirmed that electrolysis will accomplish a permanent cure by coagulation of the blood alone, we venture to question whether further and more careful observation will sustain the statement. The fact seems to be, that while the obliteration of veins in any portion of the body, by the products of inflammation, is attended with some risk, in the case of the spermatic veins the risk is considerably greater. I have myself tied the spermatic veins quite often by Reynaud's method, which is the most simple of all, and have as yet met with no fatal results; yet having become fully convinced that it is, like all the other plans, attended with more risk than ought to be incurred for a malady which in itself never causes death, I have of late relinquished it altogether. It is proper to say, also, what most or all writers have hitherto too much concealed, namely, that every method enumerated is liable to fail altogether, and in no instance, probably, have either of them ever accomplished a complete cure. According to my experience, in whatever manner the occlusion of the veins is effected, more or less of the varicosity always remains.

What I have to propose, and what I have now for some years practised, is the operation first suggested and practised by Sir Astley Cooper, who also had become fully convinced of the danger attending the ordinary methods. It consists in converting the scrotum into a suspensory bag, by the removal of a large tegumentary flap. That portion of the scrotum which corresponds to the varicocele, with a portion of the scrotum upon the opposite side, is lifted from the testis and cord, and from their investing tunics, and removed either with strong scissors or the knife. The bleeding arteries are then secured, and the wound is closed by sutures in the usual manner. The result is eventually a more complete subsidence of the varicosity than by any other plan, and the formation of a permanent suspensory bag which prevents all farther inconvenience from the varicocele.

I have never seen fit to cut away the spermatic veins at the same time; but, if they were unusually large, I should not hesitate to do so, since they would not require the ligature; and experience has shown that wounded veins, whose channels become closed spontaneously or by the aid of moderate pressure, are not very liable to a progressive or to a diffuse suppurative inflammation.

Quite recently it has been proposed to make the tegumentary ablation after the application of clamps, constructed somewhat upon the principle of Nott's linear écraseur, depending solely upon the clamp to control the bleeding; but I would rather trust to the ligatures in all operations upon the scrotum; and, to confirm the justness of my apprehensions in this regard, it will be proper to state, that I have been consulted within a few days, in a case in which, clamps having been used, the ablation effected, and sutures applied, a secondary hæmorrhage took place, forming an enormous thrombus under the integument, which made it necessary to remove all the sutures and apply ligatures to the bleeding vessels; and as a final result, the entire scrotum sloughed away, leaving the testes wholly denuded. It will not do to say that this accident has not happened after an experience limited to a few operations. The method exposes to the danger of its occurrence, and in the minds of prudent surgeons this will be regarded as sufficient for its rejection.

Epithelioma of the Scrotum. Syn., Carcinoma Epitheliosum, R. C., Chimney-sweep's Cancer.

In Great Britain and in some other portions of Europe chimney-sweep's cancer is quite common; but in this country it is exceedingly rare. It appears to be caused in most cases by the continued action of soot, mingled perhaps with the natural secretions of the tegumentary glands, which lodge in the rugæ of the scrotum. The malady presents itself at first as an excoriation, as a tubercle, or as a papilliform growth resembling a wart, and in its progress it involves first the superficial structures and then those which lie more deep. Eventually extensive ulcerations, with fungus, bleeding, and sloughy granulations, enlargement of the inguinal glands, and a general failure of the various functions of the body, indicate that the disease, which was at first probably purely local and sufficiently simple in its character, is resigned to malignancy.

Treatment.—Like tegumentary epithelioma elsewhere, if removed by the knife in such a manner as to include all the tissues involved, and at an early stage of its progress, a cure may generally be anticipated.

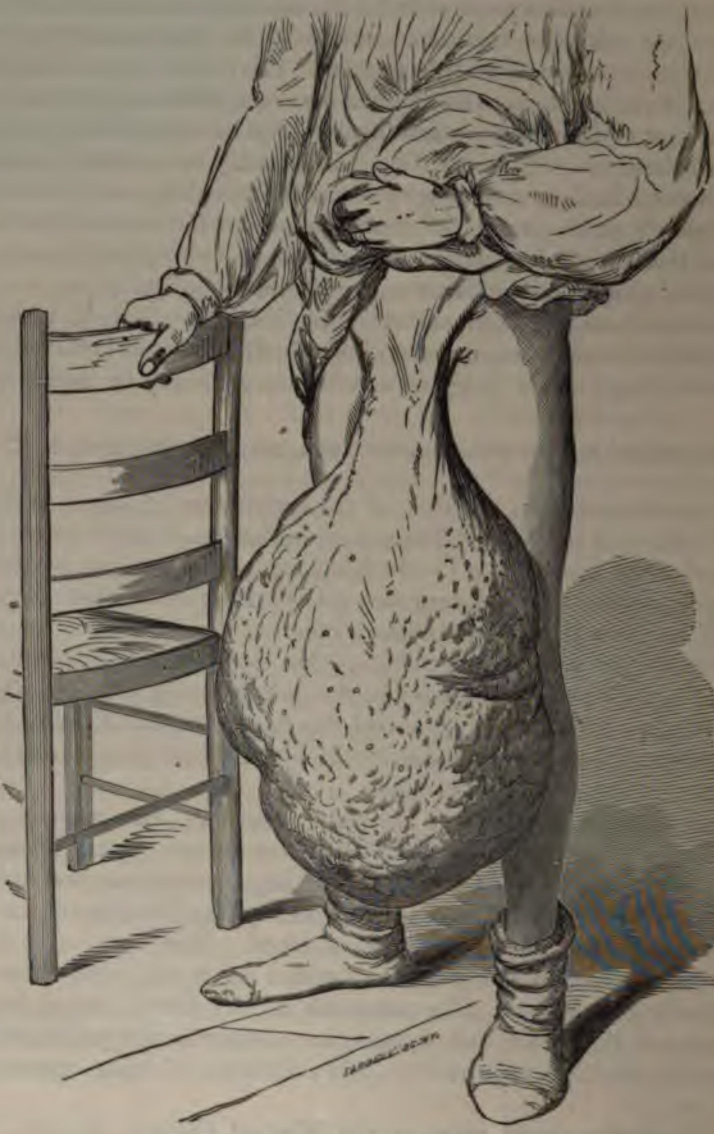
Elephantiasis Arabum of the Scrotum. Syn., Elephantiasis Scroti, R. C.

Elephantiasis arabum, whether of the scrotum or of other portions of the body, is in the United States a rare affection. Only three cases of elephantiasis of the scrotum in which the tumor had attained much size have been reported by our surgeons, all of which occurred in negroes In 1837 Dr. Picton, of New Orleans, removed successfully a tumor of this kind weighing fifty-three pounds. Dr. Bozeman, of this city, has removed one weighing forty pounds, the patient dying subsequently of peritonitis; and Dr. Thebaud, also of this city, removed a third in 1866, which weighed before removal sixty-three and a half pounds, and after removal fifty-one and a half pounds.

Treatment.—Extirpation is the only remedy. The arteries and veins connected with tumors of this kind are always greatly increased in size, and unless care is taken to tie the larger vessels as soon as they are divided, or the operation is made with rapidity, the life of the patient may be endangered by the loss of blood. The bleeding will be lessened somewhat by elevating the scrotum a few minutes before the operation is commenced. The testes are usually found buried in the upper part of the tumor, and the operation is necessarily prolonged by the careful dissection required to avoid mutilation of these organs and of the penis.

Of 113 cases operated upon at the Medical College Hospital, Calcutta, only 21 died. The causes of death were pyæmia in 9 cases, diarrhœa and exhaustion in 7, shock in 2, tetanus in 2, and gangrene in 1. The tumors varied in size from fifteen ounces to seventy-five pounds, but most of them were small. In four cases operated upon by Clot-Bey in Egypt, the tumors weighed respectively one hundred and ten, seventy, eighty, and sixty-five pounds. All of these recovered. The conclusion drawn from the results of the above cases, and of others upon record, is that the operation of removal is more dangerous during the early stage, while the tumor is growing and more or less inflammatory

Fig. 445.

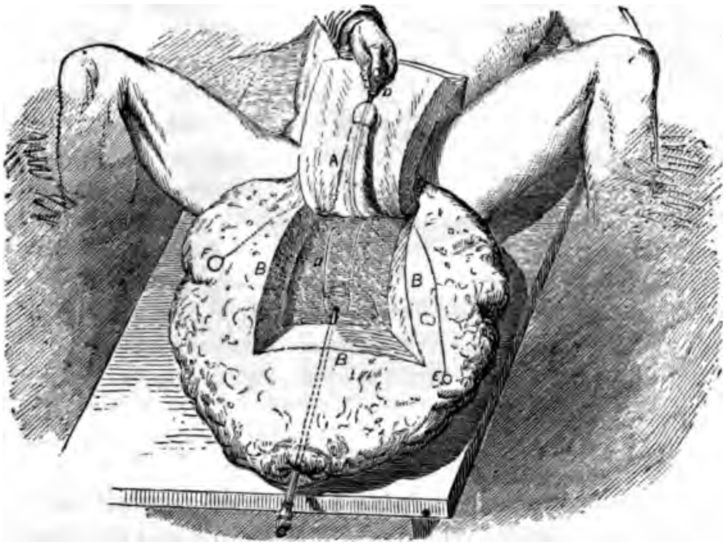


Dr. Thebaud's case of Elephantiasis of the Scrotum.

action exists, than at a later day, when the growth has ceased, and the inflammation has entirely disappeared.

The case reported by Dr. Thebaud is very instructive. The patient, Isaac Newton, was twenty-two years old, and a native of Georgia. In 1859 he had suffered a contusion of the scrotum, causing some swelling and pain, and from this time, for a period of about three years, during which the tumor was rapidly increasing in size, the pain was occasionally excessive. Subsequently he suffered very little, but was unable to walk on account of the great size and weight of the tumor. At the time of the operation he was in excellent health, and he was able to urinate without difficulty, although the penis was buried completely in the hypertrophied tissues. The glans penis was eighteen inches from the surface of the integument, the urine escaping through a canal formed by the walls of the scrotum. The position of the right testis could be determined by the sensations experienced by the patient when firm pressure was made; the left could not be recognized. The patient being placed under the influence of ether, a sound, extemporized from a stove-poker, was passed through the canal in the scrotum to the glans penis, and upon its extremity a bilateral crescentic incision was made twelve inches in length. Two vertical incisions were then made, one on each side, which united below with the extremities of the first. The flap, including the penis, was now dissected up, and a sound introduced into the bladder. The right testis was easily found and lifted by dissection from its bed. The left testis was not found until after the removal of

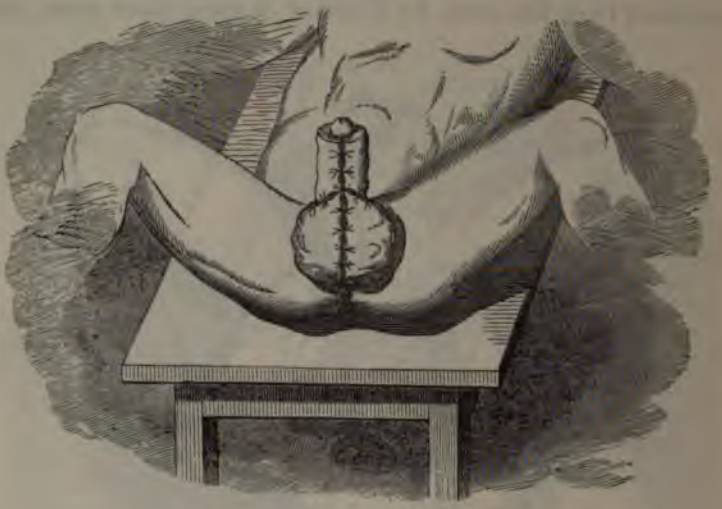
Fig. 446.



A, Penis, with Sound introduced; *BBB*, Lines of Incision for Central Flap; *D*, Central Flap turned back; *E*, Position of Left Testicle; *F*, Right Testicle; *d*, the dotted line indicates the position of the Penis before it was dissected from its bed. The sound is also shown passed up through the canal to the head of the Penis.

the tumor, when it was discovered to be much atrophied. All but a small portion of the scrotum was now removed, and the penis and testes being brought into position, the wound was closed. Nearly one hundred vessels, most of which were large and open-mouthed veins, were tied during the operation. His recovery was rapid and complete.[1]

Fig. 447.



Appearance after Operation.

Spermatorrhœa, R. C.

From the earliest period at which the organs of generation are fully developed, occasional seminal emissions appear to be inevitable, and it is not certain but that such emissions are necessary for the complete preservation of the virile functions. It is only, therefore, when they occur too frequently that they can properly be regarded as evidence of functional derangement; as, for example, when the emissions take place as often as once or twice in a week, and are followed by a sense of exhaustion, or by other indications of disturbance of the nervous system. Diurnal emissions are of more serious import than nocturnal.

The most common cause of spermatorrhœa is self-pollution. It may be occasioned, also, by the presence of ascarides in the rectum, or by rectal irritations of any kind, by gonorrhœa, stricture, or excessive venery. Sometimes it occurs in persons of studious and sedentary habits, without any special or assignable cause.

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[1] A Case of Elephantiasis Arabum, successfully operated upon by J. S. Thebaud, M.D., Surgeon to the Hospital of the Colored Home, St. Vincent's Hospital, etc. *New York Med. Jour.*, May, 1867.

Pathology.—There is but one point in the pathology of this affection which has been distinctly made out, namely, a preternaturally sensitive and irritable condition of the posterior wall of the prostatic portion of the bladder, which sometimes can be recognized by external pressure, but more certainly by the introduction of a sound or catheter. It is easy to understand how a continued hyperæsthesia in the neighborhood of and involving the ejaculatory ducts, should tend to the production of erotic sensations and seminal emissions.

Treatment.—If the emissions are only occasional, and do not affect the general health, no treatment is required; and these constitute a majority of those cases which are brought under the notice of the surgeon If, on the other hand, both the general health and the mental functions are sensibly impaired, as is sometimes the case, a careful inquiry must first be made to ascertain the cause, and the proper measures must be adopted for its removal. In nearly all of these latter examples, there is evidence of a loss of tone in the entire nervous system, and it will be proper to recommend plain but nutritious diet, mineral tonics, cold bathing, with frictions, and out-door exercise. All stimulating liquors and tobacco are hurtful.

The emissions take place usually at night, or toward morning, when the patient has become warm in bed, and is sleeping soundly. In such cases the patient must be enjoined not to eat a hearty meal within four or five hours of retiring; he must empty his bladder before getting into bed; the bed should be rather hard and the coverings light, so that his sleep shall be less profound; he must lie upon his side, never upon his back, and, if possible, he should rise a little past midnight, or when he has been in bed about four hours, and, stepping upon the cold floor, empty his bladder again. A strict adherence to these rules seldom fails to prevent nocturnal emissions; and, if the habit can be interrupted by these or any other measures several weeks, the patient is in a fair way for recovery.

The object in requiring the patient not to rest upon his back, and to empty the bladder often, is to prevent an accumulation of urine upon the trigone and neck of the bladder, where its presence is liable in children to cause involuntary discharges of urine, and, in those who are older, involuntary discharges of semen.

As a direct means of overcoming the morbid irritability of the neck of the bladder, no plan is more often successful than the application of nitrate of silver, first suggested and practised by Lallemand; but the instrument invented by Lallemand, and employed by most surgeons up to a very recent date, has proved very insecure, and ought to be wholly laid aside. In addition to the numerous accidents which have attended its use, and which have from time to time been recorded by surgeons, it has happened under my own observation, also, that a young physician who had borrowed my instrument, turned the stylet in the wrong direction and broke it, leaving the cup containing the caustic and several inches of the coil in the urethra, from which it was with great difficulty, and not without causing much laceration, subsequently removed by narrow urethral forceps. Since then I have ceased to use Lallemand's instrument myself, and have never recommended its use to others, but I have employed instead a method similar to that which I have seen more recently recommended by Mr. Erichsen. A silver catheter, furnished with a large number of small holes, instead of the usual long fenestra, at its vesical extremity, is introduced to the neck of the bladder; when a piece of sponge, fastened to the end of the wire stylet, and saturated with a solution of the nitrate of silver, is carried forcibly to the vesical extremity of the catheter, driving the caustic solution out upon the mucous membrane. In the first experiment, the strength of the solution ought not to exceed five grains to the ounce. If this fails, after the lapse of two or three weeks, ten or twenty grains to the ounce may be employed.

Latterly I have derived benefit in a few cases from the daily introduction of a steel sound of moderate size; such, for example, as a sound of the size of No. 8 or 10, English catheter scale. In children a tight foreskin—phimosis—is an occasional cause of erections and of seminal emissions, which should be relieved by a free incision.

Beyond these measures, all of which it must be acknowledged are liable to fail, nothing but wedlock can hold out much promise of cure; and this has proved successful in my observation almost without an exception—not always immediately; but the improvement is generally manifest within a few weeks or months, and a complete cure can in most cases be assured after a year or two at most. Nor, in general, need any fear be entertained that the virility of the patient will be found to have been impaired. Beyond a temporary incapacity, resulting from a lack of confidence, no failure of the virile powers is generally experienced.

I have omitted to speak of ligature of the spermatic arteries, ligature of the vas deferens, and castration, all of which methods have occasionally been practised in extreme cases of onanism and in certain cases of erotic mania. When practised for the cure of onanism, these measures have in most cases been successful; but the relief has not generally been immediate. When, however, castration has been practised for the cure of erotomania and epilepsy, it has almost uniformly proved a failure. Dr. Bell says that in all the Lunatic Hospital cases, so far as his information extends, it has been unsuccessful. At the Ohio Hospital it was tried extensively, but no valuable results followed. Mr. Holthouse, also, reports a case in which he practised castration for epilepsy, but the epileptic seizures continued as before the operation.

Spasmodic Spermatorrhœa. Syn., Spermaspasmos.—This term has been applied to that condition of the generative organs in which the ejaculation occurs prematurely, that is, prior to or simultaneous with complete erection. It sometimes attends true spermatorrhœa, but quite often it is unassociated with involuntary and frequent seminal discharges. Persons of full habit and in the prime of life are most liable to it.

Treatment.— When spermaspasmos is independent of spermatorrhœa, it usually depends upon a condition of general or local plethora, and may be relieved by abstinence from stimulating food and drinks, by the occasional use of hydragogue cathartics, and by such other internal remedies as belladonna and the bromide of potassium.

Impotence. Syn., Inopia Virilitatis, R. C.

Total absence of sexual desire and of the power of erection may be caused by long-continued and absolute continence. This kind of lethargy is sometimes induced in those who devote themselves to celibacy, and who subject both their minds and their bodies to the most rigorous discipline. Much more frequently, however, it is a result of early and excessive venereal indulgence. It ensues upon atrophy of the testes, or upon a complete annihilation of their functions, in whatever manner induced; but the power of erection often continues in these latter cases, long after the secretion of seminal fluid has ceased. Even after castration, if the castration has been effected after the development of the sexual organs, the sexual desire and erections may continue several years without any very sensible abatement, as I have observed in several instances. Impotence is sometimes caused by injuries of the head, and more often by injuries of the spine; it is also one of the signs of failure of the nervous functions in advancing years. In some of these cases of impotence, spermatozoa are recognized in the occasional seminal discharges, or in the tubuli after death; in others there is a complete absence of spermatozoa. Finally, impotence may be due to congenital malformation, or defect of the generative organs.

Treatment.—When depending upon long-continued continence, the re-establishment of the functions might properly be anticipated, if the sexual appetite were encouraged and stimulated. Those examples which depend upon early and excessive venereal indulgence I have seen cured by attention to the general health, and by well-applied moral and physical restraints. The impotence of old age and all the other forms of this malady may in general be considered incurable, although some temporary improvement is occasionally observed from the use of phosphorus, cantharides, the ergot of rye, and strychnia.

Sterility.

Of late the attention of the profession has been drawn to the fact, that many cases of sterility which have hitherto been charged to the female are properly attributable to the male. With all the organs of generation apparently complete, and while the functions seem to be active and normal, the spermatozoa are sometimes found to be wholly absent, or they perish prematurely, after ejaculation, and therefore fail to impregnate.

Treatment.—No plan of treatment beyond the improvement of the general health has yet been suggested.

CHAPTER XVIII.

SURGERY OF THE FEMALE GENITO-URINARY ORGANS.

MALFORMATIONS AND DISEASES OF THE OVARIES.

Absence and Rudimentary Development of the Ovaries.—Complete absence of both ovaries is very rare, and is usually accompanied by imperfect development of the remaining genital organs; in some cases, the whole form and development of the body assumes a masculine character. When a single ovary is absent, the corresponding portion of the uterus is generally rudimentary. Both ovaries may be rudimentary. Fecundation may occur when both ovaries are imperfectly developed; but where there is a total absence of these organs fecundation is impossible, and menstruation does not occur; the sexual appetites are, however, often perfect.

Atrophy of the Ovaries. Syn., Atrophia Ovarii, R. C.—Atrophy of the ovaries is usually a result of senile changes, but it may take place in earlier life, and from causes that have not hitherto been explained.

Hernia of the Ovary (see Hernia).

Inflammation of the Ovary. Syn., Ovaritis.—Inflammation of the ovaries may be consecutive upon inflammation or irritation of adjacent organs, or it may occur as a primary affection. It may be in its origin follicular, parenchymatous, or peritoneal; although it is probable that neither the Graafian vesicles, parenchyma, or the peritoneal covering are ever seriously involved in the inflammatory action, without an implication of the other structures. Its most frequent causes are: suddenly suppressed menstruation, excessive venereal indulgence, including masturbation, gonorrhœal and other inflammations of the vaginal and uterine cavities, exposure to cold and external injuries, puerperal peritonitis, and colitis.

Ovaritis in its chronic form is indicated by a dull pain or a sensation of weight in the region of the affected ovary, tenderness, and sometimes by an extension of the pain, with a sensation of numbness, to the corresponding thigh. The pain attending chronic ovaritis is apt to be aggravated by coitus and by menstruation. In acute ovaritis there is often present, in addition to a more acute local pain and tenderness, active febrile excitement, with rigors, the rigors occurring sometimes with great frequency, irregularity, and intensity.

Treatment.—Both acute and chronic ovaritis ought always to be regarded as grave lesions, inasmuch as they are liable to terminate in the formation of abscesses, in hypertrophy, or solid fibrous growths, in cystic and malignant tumors; and, even when the inflammation terminates in the most favorable manner, the organ is frequently so maimed as to present insurmountable obstacles to ovulation, and amenorrhœa with sterility may be the result.

The treatment consists in the removal of all sources of excitement to the genitalia, in the suppression of gonorrhœal and leucorrhœal discharges, in absolute rest in the recumbent posture, conjoined with low diet, warm fomentations to the abdomen, and other general and local antiphlogistic or hygienic measures.

Abscess of the Ovary.—Acute abscesses are more likely to prove fatal than those which are the result of a chronic inflammation. Chronic abscesses generally open into the rectum or vagina, sometimes into the bladder or uterus, and still more rarely they make their way to the surface through the integument; but it is only when they open into the peritoneal cavity, which is fortunately very seldom, that the safety of the patient is seriously compromised. In most cases which I have seen, the abscess has made its way into the rectum or vagina, and a speedy recovery has ensued.

Apoplexy of the Ovary. Syn., Hæmorrhage of the Ovary; Ovarian Hæmatocele.—At every catamenial period a slight effusion of blood results from the rupture of a Graafian vesicle, but occasionally the effusion has been found in the autopsy to have been excessive; and when the blood has escaped into the cavity of the peritoneum, the hæmorrhage has been known to prove fatal. The occurrence is said to have been attended sometimes by a sharp pain in the region of the ovary, followed by tenderness, or, in case the bleeding is profuse, by symptoms of anæmia; but I am not aware that the diagnosis has ever been completely made out during life. (See Pelvic Hæmatocele.)

Oophorectomy, or Spaying.—This operation was first made by Hegar, of Germany, on the 27th of July, 1872, but owing to the prominence subsequently given to it by the operations and writings of Dr. Battey, of Rome, Georgia, it is generally known in this country as "Battey's operation."

Oöphorectomy has been practised for neuralgia of the ovaries, chronic ovaritis, dysmenorrhœa, amenorrhœa with convulsions, etc., menorrhagia, pernicious menstruation, hemorrhage from myoma, uterine fibroids, epilepsy, hystero-epilepsy, menstrual epilepsy and mania, nymphomania, and for various other general and local conditions supposed to be dependent upon the abnormal or depraved action of the ovaries.

There are two methods of operating. First, through an incision made in the abdominal walls, and second, through the vagina. By the first method an incision of not more than three inches in length is made in the median line, rather nearer the pubes than the umbilicus. The peritoneal cavity being laid open, one ovary is sought for and brought to the external opening, provided it is found not to be adherent; a strong, double, carbolized silk ligature is then passed through the broad ligament immediately below the ovary; the ligature is separated, tied firmly right and left, and cut off close, with the purpose of leaving it buried in the wound. The ovary is now excised, and the other ovary being removed in the same manner, the external wound is closed.

A few operators have preferred to separate the ovary from the broad ligament by the écraseur, but this method has been thought to expose the patient to the danger of a secondary hæmorrhage, and has been seldom practised.

The second method, which has found fewer advocates, consists in exposing the vaginal canal by a Sims speculum, acting as a retractor upon its posterior wall; drawing the uterus down and forwards with a strong hook; incising the posterior wall from the cervix downwards; introducing through the opening thus made a sharp hook, guided by the finger; seizing the peritoneum where it forms the cul-de-sac of Douglas, and drawing it out of the wound; then making into the peritoneum a sufficient incision to enable the operator to introduce his finger and a vulsellum, with which latter the ovary with its broad ligament is seized and brought down. The subsequent steps are the same as in the operation above the pubes, except that the operator is at liberty to leave the ligatures hanging from the wound or to cut them off.

Agnew, in his excellent Treatise on Surgery, has tabulated all the cases which he could find on record up to the time of the publication of his second volume (1881), including the cases which had been previously collated by Dr. Paul F. Mundé and published in 1880. The total number tabulated by Agnew is 171; of this number 139 recovered and 32 died, giving a mortality of 18.72 per cent; but in many cases it does not appear whether the maladies for which the operation was made were cured or not.

Dr. Agnew, in commenting upon Dr. Mundé's table of 120 cases, of which 28 died, a mortality of 22.6 per cent, says: "the death-rate is not much above that which follows amputation of the thigh," . . . "so that on the ground of fatality the objections against its performance are not very forcible." I protest, however, that this fact constitutes no just ground of comparison between amputations of the thigh and the operation now under consideration. The one is rarely made, except to avert impending death. It is accepted usually as the sole alternative; and if the patient recovers from the operation he is also in nearly all cases "cured."

The other is seldom made except for the purpose of relieving the patient from pain, or from disabilities which render life uncomfortable, and gradually undermine the general health. It is not then made in most cases as the sole alternative known to science, and its results are very uncertain. Agnew says correctly, "the statistics are defective as regards ultimate results;" but enough can be gathered from them to justify a suspicion that more than half have derived no permanent benefit from the operation. This question of permanence cannot be decided in the short period of time which has usually elapsed between the operation and the published report. The same reasons, also, which induce operators to report their cases prematurely, may also influence them in many cases not to report them at all, and thus the recorded cases may not give us a fair estimate of the actual death-rate: but even accepting 18.72 per cent as the average mortality, it is, under the supposed circumstances, much too great.

Finally, if, in comparing major amputations with oöphorectomy, our attention is called to the fact that amputation deprives the patient permanently of a useful member, it will be proper to remind the reader also that oöphorectomy renders the patient permanently barren.

Ovarian Tumors.

Cystic Tumors. Syn., Ovarian Dropsy; Dropsy of the Graafian Vesicles.—These cysts constitute the most frequent form of ovarian tumors. They appear to be the result of a hyperæmia or chronic inflammation of the ovaries, in consequence of which the fluid contained within the Graafian vesicles is augmented in quantity and eventually changed in quality. One vesicle alone may be implicated or several. In most examples of multilocular ovarian cysts, however, the walls evidently possess the power of proliferation, and the multiplication of cavities and loculi is the result of an active genesis in the tumor itself.

The hyperæmia which laid the foundation of these tumors continues to accompany its growth and development; in consequence of which, while it is expanding under the pressure of the contained fluid, its walls usually increase in thickness, and its vessels attain an enormous size.

The cysts may be found eventually to contain a thin straw-colored fluid resembling serum, or it may be discolored in consequence of the rupture of some of the vessels and the escape of blood. In these latter cases the fluid has usually the color of coffee. They may contain a fatty, oleaginous or gelatinous fluid; in other cases papilliform growths project from the interior walls, and give to the tumor a structure which has received the name of *cysto-sarcoma*, or, becoming infiltrated with a colloid or medullary deposit, they are termed *cysto-carcinomata*.

In rare cases one or more of the cavities contain hair of various colors, rolled or entangled upon itself, with their roots embedded in the walls; also teeth, in greater or less number, usually imperfectly developed, and some of which occupy proper dental cysts, while others lie loose in the cavity. Cysts of this character, called *dermoid*, contain also an orange or bronze colored oil or masses of fat, which have resulted from the degeneration of the pavement epithelium cells thrown off from the lining membranes of the cysts. The walls of encysted tumors have been occasionally found to be cartilaginous, and in other cases calcified.

Considerably more than half of all the examples of ovarian tumors possess a wholly non-malignant character, and are either simple unilocular or multilocular cysts, with the character of the original secretions only greatly increased and in some degree modified. True cancer of the ovaries is very rare.

Symptoms and Diagnosis.—It is not always possible to determine precisely the character of the ovarian tumor; nor, indeed, as experience has sufficiently demonstrated, to determine that the growth in question has not originated from some other organ than the ovary; but, on the whole, the number of errors committed in the diagnosis, by experienced and careful surgeons, has perhaps not been greater than have occurred in the diagnosis of herniæ, and of many other accidents or diseases for which grave surgical operations are made. It is well, however, not to underrate the difficulties in this regard.

For clinical purposes it is most important, first, that we recognize the tumor as ovarian; second, that we distinguish between the malignant and innocent growths; third, that we ascertain whether it is fluid or solid; inasmuch as it is almost exclusively fluid, innocent, ovarian tumors which can be regarded as proper subjects for surgical treatment. If a large portion of the tumor is fluid, although the remainder may be solid, the operation is not contraindicated. The conditions which are most apt to be mistaken for ovarian cystic tumors are ascites, colloid tumors involving the ovaries or adjacent structures, and fibro-cystic tumors of the uterus; but experience has shown that it is possible to confound ovarian cysts with pregnancy, dropsy of the broad ligaments, encysted tumors of the Wolffian vesicles, cystic degeneration of the kidneys, ovarian or uterine fibroids, cancer, phantom tumors, an enlarged spleen, or even a distended bladder.

In most cases, for some time prior to the discovery of the tumor, the patient has suffered from a sensation of weight, fulness, or pain in the region of the affected ovary, and in the corresponding thigh or perineum, attended with vesical and vaginal irritation, and with some irregularity in menstruation. The menstruation sometimes, although very rarely, is arrested altogether from a very early period—a circumstance which may always suggest a suspicion that the character of the tumor is malignant, or at least composite. The breasts not unfrequently sensibly enlarge; chlorosis and hysteria are often present. As the tumor increases in size it usually becomes more central in position, but, unless adherent, it may be easily displaced. I have seen double ovarian tumors which could be crossed and made to change places upon opposite sides of the abdomen.

Vaginal examination generally reveals some uterine displacements or deviations, with elevation or depression of the entire body of the uterus; sometimes the uterus is lifted and elongated; at other times compressed and partially atrophied. Encysted ovarian tumors, the contents of which are fluid, may be felt to fluctuate through the vaginal walls.

Unilocular encysted tumors rarely attain a size larger than a man's head; and they present a smooth, uniform, globular outline, with considerable fluctuation.

Multilocular cysts often fill the entire abdominal cavity, encroaching upon the cavity of the thorax; their fluctuation is more diffused but less distinct, and some irregularity of the surface may often be recognized. If composite, the different cavities contain materials differing in density, and the surface is more or less unequal.

Most malignant growths present an unequal surface; fluctuation is often absent or indistinct; they grow with great rapidity, and are accompanied with marasmus, anæmia, and other signs of the cancerous cachexy. They are often accompanied with lancinating and burning pains through the tumor; the amount of fluid accumulating within the peritoneal sac (ascites) is at an early day excessive, and out of proportion to the size of the tumor; there is also present in most cases induration of the omental and other visceral glands, and of the recto-vesical septum, due to the presence of cancerous infiltrations.[1]

The following is a brief summary of the differential signs by which we may hope to distinguish between ovarian cysts and fibro-cysts of the uterus, which are given by Dr. Charles C. Lee, of this city, in a paper communicated to the *New York Medical Journal*, for November, 1871:—

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[1] Diagnosis of Malignant Disease of the Ovaries, by T. Gaillard Thomas. *Med. Record*, June 1, 1871.

OVARIAN CYSTS.	FIBRO-CYSTS OF THE UTERUS.
1. May occur at any period, even before puberty.	1. Scarcely ever occurs under thirty—generally between the fortieth and fiftieth years of life.
2. Development rapid—usually under two years.	2. Development slow; generally over two years.
3. Aspect of face unaltered, if the general health is fair.	3. "Facies uterina" generally marked· expression anxious and dejected.
4. Fluctuation equable over the whole surface of the tumor.	4. Fluctuation confined to certain regions—generally to the upper portion, while the lower is hard and dull
5. Vaginal examination shows but little displacement of uterus—the tumor smooth and distinct from the uterus.	5. Vaginal examination shows the uterus high up or displaced. Tumor either not detected, or continuous with the uterus.
6. Mobility of the uterus independent of the tumor from beginning—pelvic adhesions rare.	6. Independent mobility of the womb confined to last stage of the disease. Pelvic adhesions common.
7. Tapping causes complete collapse of unilocular cysts—in polycystic tumors, it reveals the endocysts.	7. Tapping causes only partial collapse, leaving base of the tumor firm and indurated.
8. Fluid clear, straw-colored, serous; or viscid, clear, mucoid, albuminous.	8. Fluid either brownish, bloody, sero-purulent, muddy; or thin, yellowish, containing shreds of lymph or cholesterin.
9. When exposed by gastrotomy, the sac is pearly-blue, or white and glistening; rarely vascular.	9. Exposed sac dark, vascular, thick, and frequently fasciculated with fibrous bands.

In the diagnosis of these tumors, and especially in the attempts to distinguish them from ascites, percussion and auscultation give important aid. Valuable information may also be obtained by the use of the exploring needle.

Treatment of Ovarian Cysts.

Puncture through the Abdominal Walls, or Tapping, is a palliative measure, and intended, like tapping for ascites, to give only temporary relief, although it has occasionally been followed by a radical cure. It is limited, moreover, as a palliative measure, almost exclusively to unilocular cysts, or at least to those which are neither composite, solid, nor malignant. A multilocular tumor may be sensibly diminished in size by the evacuation of a single cavity; but, if the diagnosis was well made out, it would hardly be thought worth while to attempt relief by this method, unless the patient was suffering very greatly, and no other surgical alternative could be presented.

In performing the operation of tapping upon an ovarian cyst, we select usually the median line, and a point as near the pubes as possible, without exposing ourselves to the risk of wounding the bladder; as, for example, at the upper end of the lower third of the space comprised between the umbilicus and the pubes. The trocar should be large, as the fluid is often too thick to escape readily through one of average size. In other respects, the steps of the operation and the precautions to be adopted are the same as in the operation for ascites.

If we propose to operate upon a cyst which is limited to only one side of the abdomen—and the occasions for the operation, under these circumstances, must be exceedingly rare—the trocar must be introduced at the most salient point of the projecting mass.

Puncture through the Vaginal Cul-de-Sac.—Puncture of the cyst through the vaginal walls has proved more successful as a radical means of treatment than the anterior abdominal tapping, for the reason that the opening being more depending, permits the fluid to drain off more completely; but the conditions requisite for the performance of this operation are not often present. In many multilocular tumors, solidified masses occupy the lower portions; and even if this circumstance did not offer an insuperable obstacle to the operation, a radical cure could not reasonably be anticipated in tumors of this class. It is only, therefore, in examples of simple, unilocular cysts, which can be felt to distinctly fluctuate through the vaginal walls, and which sensibly encroach upon the vaginal canal, that the operation is justifiable.

The opening is to be made with a long and large trocar and canula, the length of which ought to be at least ten inches; and the canula must be permitted to remain several days or weeks, until the sac has had an opportunity to contract. In case the fluid is found too thick to escape through the canula, the opening may be enlarged by a long, straight, probe-pointed knife, introduced through the canula; and, when the extremity has passed an inch or more beyond the extremity of the canula, by withdrawing both the knife and canula, and pressing laterally, the requisite incision may be made. It would be possible to contrive a canula composed of two half cylinders, united longitudinally, which could be expanded by a hollow piston, after the trocar is withdrawn.

Free incisions of the abdominal wall and sac, recommended as a substitute for the trocar and canula, by Ledran, Velpeau, and others, have presented no results which would encourage their repetition.

Excision of a portion of the Sac, for the avowed purpose of emptying its contents into the peritoneal cavity, and then closing the external wound, trusting to absorption for the removal of the fluid, has, so far as I am informed, no other advocate than Baker Brown.

Subcutaneous Puncture, Electricity, and Acupuncture are resources to which I cannot attach much importance, and the merits of which it is hardly worth while to discuss.

Injection of the Sac with Stimulating Fluids.—This method, advocated by Boinet, Jobert, Trousseau, Brainard, and many other surgeons a few years since, has fallen of late into disrepute, on account of the great number of serious accidents which have been known to result.

The operation consists in performing paracentesis in the usual manner, emptying the sac as completely as possible, and then introducing dilute tincture of iodine, or a weak solution of the iodide of potassium; repeating these injections from time to time until a cure is effected. Experience has shown, however, that while a certain number of cures have in this manner been effected, the fluid injected has sometimes escaped into the peritoneal cavity; and even when this has not happened, iodism, inflammation, and suppuration of the sac have ensued, or acute peritonitis has been set up, which has terminated fatally.

In no case can the operation be considered as justifiable, except in simple unilocular tumors with serous contents, and when the sac is not adherent to the abdominal walls. When the sac is thus adherent, the danger of extravasation into the peritoneal cavity is diminished, but contraction and obliteration of the cystic cavity is rendered impossible.

Extirpation of the Ovarian Cyst, or Ovariotomy.—Several countries contend for the honor of having first suggested extirpation as a remedy in ovarian tumors; but without stopping to investigate the merits of these claims, I shall deem it sufficient to say, that the first operation of this kind was made by Dr. Ephraim McDowell, of Kentucky, in December, 1809. The tumor, when removed, was found to be partly solid and partly fluid, and weighed twenty-two pounds and a half. The patient, Mrs. Crawford, of Kentucky, then forty-seven years of age, made a complete and rapid recovery, and on the twenty-fifth day returned to her home, sixty miles distant. She subsequently enjoyed excellent health, and lived to be seventy-nine years old. Before his death, Dr. McDowell made the operation of ovariotomy thirteen times.

Operation.—The patient being placed upon an operating table and under the influence of an anæsthetic, an incision is made in the median line, commencing a little below the umbilicus and extending downwards four inches or more toward the pubes. When the peritoneum is reached the operator should make a little delay, to see that all vessels requiring the ligature have ceased to bleed. It is proper to remind him, also, that the peritoneum has sometimes been mistaken for an adherent sac, and that in consequence of this mistake it has been dissected from the walls of the abdomen by the hand of the surgeon. The peritoneum is now opened carefully to nearly the whole extent of the external incision, and the sac is at once brought into view. If the case is complicated with ascites, so much of the fluid as rises promptly and spontaneously to the opening may be permitted to escape, while with the index finger the surgeon makes a partial exploration to determine the presence and amount of adhesions. Substituting for the finger a long, silver probe, he may cautiously extend the exploration, if he thinks it necessary, or he may introduce the entire hand when doubts still remain as to the existence of adhesions. The adhesions, if discovered, should be removed by the hand alone, if possible, and before the cyst is opened.

A large curve-pointed needle, armed with a strong ligature, is passed through the cyst about two inches from the lower angle of the wound, including one or two inches of the cystic parietes, and the ligature committed to an assistant with instructions to draw upon it only with sufficient force to retain the sac in contact with the abdominal parietes. While another assistant very gently supports the sides of the abdomen with his hands, the surgeon plunges his bistoury into the tumor and makes an opening at first only half an inch or one inch in length. If the contents are thin they will be expelled in a jet from a small orifice, and are in no danger of falling into the peritoneal cavity. If, however, the fluid is more consistent or gelatinous, or if the contents prove to be still more firm as in colloid growths, the sac must be freely enlarged. In either case the sac, including the orifice, must be slowly and carefully drawn out as the fluid escapes until the whole, or as much as possible, is without the cavity of the abdomen. The vulsellum will sometimes be required in holding and withdrawing the cyst; and a large gum-elastic tube will be of service in conducting the fluid into the pail. The pedicle is now seized below the sac, and being transfixed with a large needle, armed with a strong whip-cord ligature introduced double, the ligature is cut, and the two portions, which are of equal length, are tied separately upon the opposite sides of the pedicle. One end of each ligature is then cut half an inch or less from the pedicle, and the remaining portions brought out of the wound. The pedicle is best divided by a strong sharp pair of scissors, curved upon their flat sides; but the division must not be made nearer than within half an inch of the ligature or there will be danger of its becoming loosened.

When it is observed that all hæmorrhage has ceased, the wound is carefully closed by sutures placed at intervals of about one inch, each suture being made to transfix the entire thickness of the parietes, except the peritoneal surface; and the ligature attached to the pedicle is brought out at the lower angle of the wound. Between the sutures narrow strips of adhesive plaster may be placed, and the whole length of the wound then covered with a sheet of lint, smeared with simple cerate. The entire front and sides of the abdomen should then be covered with loose cotton batting, and enclosed with a broad flannel band, secured in place with sufficient firmness to give moderate and equable support to the viscera.

These are the simple rules which will govern us, in most cases, in the performance of this operation; but a few additional suggestions will be required for such as are inexperienced, and to provide for certain contingencies.

If the patient is in perfect health, no preparation will be required beyond emptying the bladder and the rectum, perhaps, immediately before the operation, and the exhibition of an anæsthetic. If it is thought necessary to unload the bowels, the cathartic should be given at least thirty-six hours before operating. The temperature of the room should be sufficiently elevated to obviate any sudden cooling of the surface of the body, and of the viscera, when exposed; but it is doubtful whether it is necessary to demand a temperature "of 70° or 75° Fahrenheit, well moistened with steam," which is exceedingly uncomfortable to the operator, and must, I think, prove somewhat depressing to the patient. In the first instance, the incision need be no longer than I have directed; but if the adhesions are found to be very extensive, and cannot otherwise be reached and broken up, or if the tumor proves to be multilocular, or in part solid, and is very large, the incision must be extended upwards, in the direction of the ensiform cartilage.

Vessels which bleed persistently, after the separation of adhesions, must be tied with delicate silk ligatures, the ends of which are to be subsequently brought out of the wound, or they may be touched with tiny pieces of ice, held securely in an instrument constructed like a litholabe. A small mop, saturated with hot water, will sometimes quickly arrest the bleeding of these small vessels.

When the sac is adherent in front, the operator is in danger of confounding the two peritoneal layers and the sac with each other; and he is liable, therefore, on the one hand, to dissect the parietal peritoneum from the abdominal walls, and, on the other, to dissect the visceral peritoneum from the sac, under an impression that he is separating the two peritoneal surfaces from each other.

The large trocar and canula devised by Spencer Wells, furnished with a vulsellum for holding the sac, and to which a large tube may be attached to conduct off the fluid, is a very ingenious instrument, but it is certainly not always required, and I have seen it sometimes rather embarrass than aid the surgeon in evacuating the cyst.

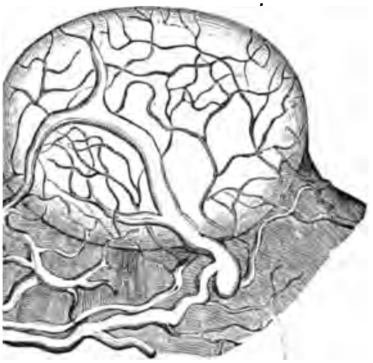
In reference to the ligation, section, and final disposal of the pedicle, surgeons have entertained very different opinions. Mr. Spencer Wells has invented a clamp, the construction of which is familiar to most surgeons, which is fastened upon the pedicle and retained outside of the abdominal walls. The objections to this instrument are, that it rests heavily upon the inflamed and sensitive belly, and that, in case the pedicle is not very long, it is necessarily put upon the stretch—a condition calculated greatly to increase the inflammatory action. In e of long pedicles, however, it possesses certain advantages, such lity of application and security, which have justly entitled it to

ıs been suggested to employ fine wire or the common silk ligand, cutting them closely, to leave them buried, trusting that they her become encysted, or make their way quietly out of the body ı a small sinus. When this method is adopted, the pedicle is y close to the ligatures. The success of this procedure has ıch as to encourage its repetition, although I cannot think it is ıt to enable us to decide fully upon its value. An expedient ıctised by Handyside, in 1846, is to convey the ligatures through ina, by the aid of a large needle; and others have occasionally l his example. The écraseur cannot be regarded as having ıstained the claims of its advocates, and especially because it t with sufficient certainty guard against hæmorrhage; yet it is ıended, and has been of late employed by our most experienced rhaps, most successful American operator, Dr. Atlee, of Phila-. To the stump Dr. Atlee subsequently applies either the per-e or perchloride of iron as a styptic. On the whole, however, I there is no method yet devised which will answer all the exi-, in so large a proportion of cases, as the whipcord ligature, as I have already directed.

after-treatment must be conducted upon those general princi-ich govern the treatment of other belly wounds.

Tumors of the Broad Ligaments. Syn., Dropsy of the Wolffian Vesicle.

Fig. 448.



ur of Broad Ligament, with unusual development of Vessels. 30 diam. Wedl.

This tumor is generally of small dimensions, varying in size from a pea to an orange; occasionally, however, it attains a much greater size, and might be mistaken for an ovarian cyst. It is usually a disease of early life, and is sometimes congenital. There are no positive signs by which a cyst of the broad ligament can be distinguished from a cyst of the ovary; but in case the operation of ovariotomy ıdertaken, and the tumor should be of the character now de-no doubt the surgeon ought to proceed with its removal, casting ture about the broad ligament and Fallopian tube.

"Alexander's" Operation for Retroflexion of the Uterus.

An operation known among gynæcologists as Alexander's operation has lately been practised for the relief of retroflexion of the uterus. It consists in exposing, by incision, the ends of the round ligaments, and drawing them out sufficiently to replace the womb, cutting off about one inch of the ligaments, and then stitching the cut extremities to the edges of the rings. I only mention it to say that it exposes the patient to the imminent danger of pelvic cellulitis with all its serious consequences; that in cases where the uterus is not adherent or malformed, there either exists no necessity for its rectification, or there are other and perfectly safe modes by which it can be accomplished; or if it be adherent or malformed, Alexander's method is wholly incompetent to accomplish any good. Already among the few cases that have been reported, I have seen one death mentioned, and a gynæcologist has said to me that he has met with the same result. In another case, troublesome abscesses followed; in one, the operator could not find the cord, it being, as is often the case, split into small and stray filaments at the point of its attachment to the pubes, and in no case have the reports supplied me with any evidence that the patient was benefited.

It seems to me incredible that any person who has acquired even the rudiments of surgical science should perform an operation so unsound in theory, and plainly so unsafe in practice.

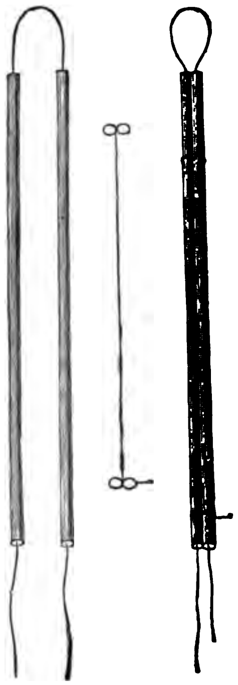
Uterine Tumors.

Fibrous Tumors of the Uterus may be developed in the parenchyma of the organ, or from the submucous or subperitoneal surfaces. They arise more frequently from the body or fundus of the uterus than from its neck. They may remain attached to the uterus by broad bases, or by narrow and somewhat flexible pedicles. Fibrous tumors, of submucous origin, which occupy the cavity of the uterus and have narrow pedicles, are termed **fibrous polypi.** These tumors often grow very slowly; and, when their growth is mainly at the expense of the exterior wall of the uterus, they may cause for a long time but slight local or general disturbance. When, however, they encroach upon the cavity of the uterus, they soon give rise to various functional disturbances, with frequent hæmorrhages and pain.

Treatment.—Although fibrous tumors of the uterus have sometimes disappeared spontaneously, and especially after parturition, as if by absorption, or by strangulation, yet we have no satisfactory evidence that such a result has ever been accomplished or aided by therapeutic means.

ever, the fibrous growth is intrauterine, and has assumed a being attached to the uterus by a tolerably narrow pedi- may be accomplished by either the ligature, the écraseur, sion. Of these several methods excision is to be preferred tachment of the pedicle is at or near the neck of the tumor is small, it may be excised from this situation ing the uterus; but when it has considerable volume, so tirely or in a great measure the vaginal space, manipula- difficult or impossible until the tumor with its uterine

Fig. 449.



Gooch's Uterine Polypus Instrument.

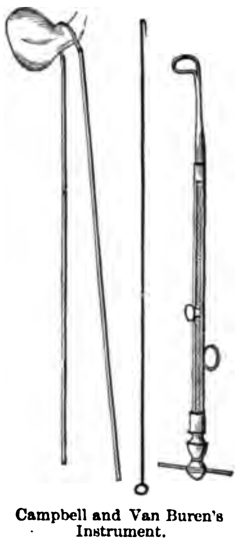
rought without the vulva. For this purpose the patient well under the influence of an anæsthetic, when the poly- zed by the hand or a vulsellum, and with slow and grad- e uterus will descend until, in most cases, the os is com- . The excision can now be effected by strong scissors or e hæmorrhage which results is seldom excessive, and the uickly to its normal position.

ypi having rather narrow pedicles, and springing from fundus of the uterus, can be removed very safely by twisting the pedicle upon itself until the separation is completed; but polypi thus attached having pretty broad pedicles can only be removed by the écraseur or by the ligature. For the application of the ligature I have employed successfully Niessen's double canula, modified by Gooch. This instrument is composed of two canulas, each eight or ten inches in length, by the aid of which the cord is passed around the pedicle close to its point of attachment. As soon as this is effected, two sets of rings, made fast to the two extremities of a long rod, are projected upon the two canulas, and the ligation is thus completed.

A better instrument, however, is that invented by Drs. Campbell and Van Buren, in which the two canulas are approximated by a shield acting in the same manner as the rings of Gooch's apparatus. When the canulas are thus embraced the shield is thrust forwards, and the canulas withdrawn. By the action of a screw the ligature can now be tightened indefinitely. A long wire bent at the extremity accompanies the instrument, to facilitate the introduction of the cord into the canulas.

Sessile Fibrous Tumors, or fibrous growths having broad attachments—to which alone some recent writers have restricted the term fibrous "tumors" as distinguished from fibrous "polypi"—as has been already observed, in a few cases disappear spontaneously; or, having attained a certain size, their growth is permanently arrested. In other cases they undergo a spontaneous strangulation and enucleation; or they may eventually become polypoid, and thus place themselves in a more favorable condition for removal; occasionally, however, in the opinion of some surgeons it is justifiable to attempt their extirpation while they yet remain embedded in the uterine walls; as for example when the tumor is not large and is already partially extruded from the uterus; or, when it is large and not extruded, but the patient's life is threatened by hæmorrhage.

Fig. 450.



Campbell and Van Buren's Instrument.

There are two methods which have been practised, termed respectively "primary" and "secondary enucleation." The method by primary enucleation consists in making a long incision over the centre of the tumor, through the mucous membrane, and fairly into the substance of the morbid growth, and enucleating it with the fingers or by the aid of blunt and curved instruments; in this manner completing at once its separation from the structure of the uterus and its mucous covering. In the method termed secondary enucleation the operation is commenced in the same manner, but the enucleation being partially effected, the tumor is left *in situ*, with the expectation that, its vascular supply being in a great measure cut off, it will perish, and be thrown off by a process of sloughing or spontaneous separation. To encourage and expedite this process it is sometimes advised to cut into the tumor freely in various directions, after the mucous membrane has been peeled up, or to cauterize it; and subsequently ergot is given, to induce uterine contraction and the expulsion of the mass. Both methods seem to have been about equally successful; but the rate of mortality—probably more than fifty per cent.—is too great to entitle either operation to be considered as yet an established and appropriate surgical expedient; and more especially is the practice rendered questionable, since it is observed not unfrequently that the mere pressure of the tampon, employed from time to time to arrest the bleeding, often induces such uterine contraction as to expel the fibrous growth, and to cause it to assume a polypoid form, after which its removal becomes a comparatively safe and easy operation.

Fibroid Recurrent tumors of the uterus are not often observed. It is said that they are more easily enucleated than the simple fibrous; but if the removal of a fibrous uterine tumor by this process is still a matter of questionable propriety, the removal of a tumor, known to be recurrent, by enucleation cannot be justified.

Mucous Polypi of the uterus usually grow from the cervix, but they may originate from any point of the interior wall. They seldom exceed the size of a pigeon's egg, and are often much smaller. The surface is smooth, vascular, and they feel soft to the touch. Owing to their exceeding vascularity and delicacy of structure they give rise to frequent and copious hæmorrhages, but they do not occasion those violent spasmodic pains which so generally attend the presence of intra-uterine fibrous polypi or tumors.

Treatment.—Evulsion or excision constitutes the most prompt and effective means of relief.

Cystic Tumors.—The ovula Nabothii, those mucous follicles and glands which encircle the os uteri, occasionally become obstructed, and give rise to small vesicular translucent elevations having a globular or ovoid shape, and which rarely become larger than a pea or a bean. They have their analogues in those similar vesicular elevations occasionally seen upon the buccal membrane and at the orifice of the mouth.

In some examples of mucous polypi these follicles expand as the mucous membrane becomes hypertrophied, and form considerable cavities in the interior of the polypoid growth.

Treatment.—The treatment is the same as for polypi, namely, evulsion or excision.

Epithelioma of the Uterus. Syn., Cauliflower Excrescence; Cancroid.—There is no reason to believe that this malady differs essentially from epithelioma of the lip, or from the same malady as occurring in other parts of the body, except so far as certain trivial peculiarities may arise from differences in the anatomical structure of the parts involved.

Like epithelioma of the lip, it is often papilliform in its origin, but owing to the greater vascularity and density of the tissues, it is more disposed to excessive proliferation and development into what has been denominated a cauliflower growth or fungus. It is especially prone to attack the os uteri and cervix; it is at first, and for a long time, a purely local affection, but, if not destroyed, invariably assumes the character of true cancer eventually. Virchow and others believe that, notwithstanding the great similarity existing between this disease and epithelioma of the lip, the points of difference are sufficiently numerous to entitle it to be classed as a distinct malady, and as peculiar to the female sexual organs. I have already expressed a contrary opinion; but in a clinical point of view the decision of this question is unimportant, since the prognosis and treatment, it is universally admitted, are the same.

Treatment.—So long as the disease has not invaded the body of the uterus or the vagina a cure by excision is possible; and the earlier the operation is practised the better will be the chance of recovery. In determining the propriety of an operation the operator will be governed, not at all by the size of the growth, or of the cancroid ulceration, but solely by the extent of the infiltration and induration at the base. If there exists an interval of sound structure between the cervical induration and the body of the uterus on the one hand, and the vagina on the other, the operation may be advised; but if not, there is, in my judgment, no experience to justify surgical interference.

Operation.—The patient being anæsthetized and placed in position upon Bozeman's table, the neck of the womb is seized with the vulsellum, drawn outside the vulva, and removed with a strong pair of scissors or the knife. The hæmorrhage, which is often considerable, may be controlled by pledgets of lint covered with the dry perchloride of iron laid upon the bleeding surfaces, or by ice-water applications.

Cancer of the Uterus.—True scirrhus is rarely met with in the uterus except as a secondary affection, and in such cases its primary invasion is usually upon the rectum or vagina.

Encephaloid cancer is more common. It is characterized especially by a more rapid development, and a remarkable tendency to decomposition.

Neither of these forms of cancer, as they occur in the uterus, demands in this place any special consideration, inasmuch as they do not differ essentially from the same varieties of malignant structures when developed in other portions of the body.

Treatment.—Cancer of the uterus always terminates fatally, but its duration is variable. In some cases of hard cancer the patients survive a number of years; it is seldom, however, that life is prolonged beyond two or three years. Encephaloid cancer is usually much more rapid in its progress.

The acrid and offensive discharges which accompany all forms of uterine cancer and epithelioma demand incessant attention. One grain of carbolic acid to four ounces of tepid water, or weak solutions of chlorinate of soda, chloride of lime, or chloride of zinc, will in a great measure correct the fetor. In addition to this, frequent injections of tepid water, and mucilaginous or mild astringent lotions, will be found useful.

Extirpation of the Uterus.

There are numerous cases upon record of the accidental ablation of the womb. It has been torn away under the supposition that it was the placenta, by ignorant accoucheurs, one example of which has come under my own notice; a chronic inversion or prolapse of the uterus has been mistaken for a polypus and removed by the knife or ligature; uterine fibroids and malignant growths involving the uterus have been diagnosticated as ovarian tumors, and the error has not been discovered until the uterus with its appendages have been found buried in the mass of morbid structures removed; attempts to amputate the cervix have resulted in the unintentional extirpation of the entire organ. Without the means of determining with statistical accuracy the results of these operations, I am nevertheless sufficiently informed to say that with rare exceptions these patients have perished, and in most cases very speedily. Surgeons have, however, from time to time, thought it proper to recommend and to practise extirpation of the uterus, either through the abdominal walls or through the vaginal canal, but with no better success than has attended its accidental ablation. I cannot, therefore, consent to place the operation among legitimate surgical expedients, and for this reason it will be unnecessary to describe any of the several methods of procedure which have been adopted.

Hysterotomy. Syn., Cæsarian Section.

Circumstances occasionally arise which render this operation proper and necessary, as, for example, the sudden death of the mother while the fœtus may be supposed to be yet alive, rupture of the uterus and escape of the fœtus into the peritoneal cavity, or such a degree of deformity of the pelvis as must render delivery by the natural passages impossible.

According to the investigations of one writer, of 424 women upon whom the operation has been made, 210 died; others have placed the mortality at 63 per cent., while some place it as high as 67 per cent. My own conviction is, that if all the unpublished cases were gathered the mortality would be found to be considerably higher. In this country the operation has been made successfully by Gibson, Page, and Neill of Philadelphia, Jeter of Georgia, McClelland of Iowa, and perhaps by others. Gibson operated successfully in two consecutive pregnancies upon the same woman.

Operation.—An incision is made along the linea alba, from the umbilicus to within one or two inches of the pubes; the peritonæum, being exposed, is carefully laid open; and while the lips of the abdominal wound are held asunder by retractors, the surgeon makes an incision through the uterus corresponding to its vertical axis, bringing into view the membranes. If possible the membranes should now be ruptured, and the waters evacuated through the vagina; but if this is impracticable, they must be opened through the incision, the abdominal walls being at the same moment pressed closely against the sides of the uterus. While assistants maintain the wound in position by the aid of hooks, the child is delivered by the hands of the surgeon; and subsequently the membranes and placenta are extracted in the same manner, provided it is found impracticable to remove them by the natural passages. The wound in the uterus closes, and its bleeding is usually controlled by the force of its own contractions; and so soon as this is observed to have taken place the tegumentary wound must be closed by sutures.

Extra-uterine Pregnancy.

There are two forms of extra-uterine pregnancy: one in which the ovum is detained and developed in the ovary, the other in which the ovum is arrested in the Fallopian tube, called respectively ovarian and tubal pregnancy. In a few rare examples, intra and extra uterine pregnancy have occurred simultaneously; a remarkable example of which was reported in the *Michigan University Medical Journal,* in 1870, by Prof. A. Sager, of Ann Arbor, Mich.

The signs of extra-uterine pregnancy are the usual signs of intra uterine pregnancy, including appreciable enlargement of the uterus, to which are generally added, by the fourth or sixth week, pains resembling colic in one of the iliac regions, accompanied with circumscribed tenderness, occurring at irregular intervals, and generally attended by nausea, debility, torpid bowels, and occasionally by vesical and rectal tenesmus. In a large proportion of cases, the colicky pains are accompanied with or followed by sanguinolent discharges, mingled with shreds and clots; the discharges resembling what is often observed in painful menstruation and in threatened abortion. No enlargement at the actual seat of pregnancy can usually be detected earlier than the second or third month, and generally not until much later.

In a surgical point of view, these cases may be divided into six classes:—

First, those in which the diagnosis is complete at an early period, and no accident, such as a rupture of the cyst, or other complication, has yet occurred. With a view to determine the value of surgical interference in this class of cases, Mr. Hutchinson has collected all the operations at that time recorded; and he informs us that, of sixteen women operated upon, nine died. The ratio of mortality, when contrasted with the results obtained by delay, does not seem to encourage a repetition of the operation.

Second, those in which the sac is ruptured within a few months after conception, usually in the second or third month, and the patient dies speedily of internal hæmorrhage. These constitute a large majority of the whole number.

Dr. Rogers, of this city, has attempted to show that in no case upon record, belonging to this class, has the patient ever escaped speedy death—perhaps one-half have died within twenty-four hours—and he suggests, therefore—and later experience has confirmed the value of his suggestion—whether prompt surgical interference may not offer a better chance of life.[1] With this view, he has very properly considered carefully the symptoms of extra-uterine fœtation, and especially the differential signs which may enable the surgeon to distinguish a rupture of an extra-uterine pregnant cyst from pelvic hæmatocele, with which chiefly it is liable to be confounded. The following is a brief synopsis of these differential signs:—

In the case of the rupture of the cyst, there have been usually, preceding the rupture, signs of pregnancy, and the colicky pains, etc., which have already been described. The rupture usually takes place during one of these paroxysms, but it may occur without any premonition. In either case, an acute pain is immediately experienced in one of the iliac regions, which is soon followed by nausea, pallor, prostration, and syncope; the usual signs of collapse from loss of blood. As the blood must accumulate chiefly in the most depending portions of the peritoneal cavity, there will be present also dulness on percussion in these regions, and, perhaps, fluctuation. The abdomen is sensibly enlarged, but not tympanitic or tender. No distinct or appreciable tumor can be found in the iliac region, if the pregnancy has not exceeded two months.

Pelvic hæmatocele has been preceded usually by no signs of pregnancy, or by any other special symptoms. The collapse is more gradual. If, as rarely happens, the blood is not poured into the peritoneal cavity, there will be circumscribed dulness and tenderness, and, perhaps, fluctuation; and these conditions will not be changed by change of position: there will be a recognizable tumor at the seat of the hæmatocele, often in the iliac region, and general enlargement of the abdomen, with tympanites; the uterus will be normal in size, but perhaps displaced.

The operation will consist in exposing the peritoneal cavity through an incision in the abdominal walls, removing that portion of the Fallopian tube involved, or the ovary, possibly a portion of the broad ligament, securing the bleeding vessels, and in removing the extravasated blood; the closure of the wound and the after treatment to be conducted upon the same principles as in any other operation of gastrotomy.

Third, those cases in which the rupture does not take place until after the third month. These examples are less numerous; and, in several cases upon record, the patients have recovered. The fact that recovery is more likely to ensue upon a rupture at a later period of extra-uterine fœtation, finds a probable explanation in the fact that the placental attachment does not then cover so large a proportion of the walls of the cyst, and the lesions, in the cases of recovery, may have occurred in the non-vascular and membranous portions alone. It seems probable, therefore, that the chance of life may now be quite as good without an operation as with.

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[1] Rogers, *Trans. Amer. Med. Assoc.* for 1867.

Fourth, those in which the fœtus dies at any period of gestation, but causes no serious disturbance; the fœtus passing into a condition of adipocire, or, with its capsule, undergoing gradual and complete calcification. A large number of examples of this kind are recorded, in one of which the patient survived fifty-six years. It is not difficult to decide that these are not cases for surgical interference.

Fifth, when at any period, and especially when immediately following the death of the fœtus, inflammation, or violent irritation of the walls of the cyst, is set up, causing great disturbance of the general system, with pains resembling labor, and putting the life of the patient in imminent peril. Without any knowledge of the results obtained by operators under these circumstances, I do not hesitate to say that, although the conditions are unfavorable to success, laparotomy presents the only alternative.

Sixth, those in which suppuration has taken place, and the contents are extruded through openings spontaneously formed, either upon the anterior walls of the abdomen or through the vagina or rectum. Mr. Hutchinson has collected of this class 52 cases, the majority of which opened through the anterior parietes of the abdomen, and of the whole number only six are reported to have died. In a pretty large proportion of the cases, however, some aid was afforded in the evacuation of the cysts by incisions, the forceps, etc., by which interference the mortality does not seem to have been increased, while the completion of the cure was materially hastened.

When the cyst is opened by ulcerative action, as above described, and the placenta is found attached, it is better to permit it to remain and exfoliate spontaneously than to take the risks of lacerating the sac by forcible extraction.

The electrical current, employed for the purpose of destroying the fœtus in extra-uterine pregnancy, has occasionally been successful in accomplishing its primary purpose; but that more lives have been finally saved by this method than by leaving these cases to the resources of nature has not been demonstrated.

Pelvic Hæmatocele.

The term "pelvic hæmatocele" is usually restricted to examples of hæmorrhage occurring from some portion of the uterus or its appendages. The first, and probably most frequent variety, is that in which the blood is contained within the folds of the broad ligament, forming a tumor of greater or less size. In the second variety the blood escapes from the free extremity of the Fallopian tube, or from an opening in the surface of the ovary, into the peritoneal cavity. In the first variety above named, the blood, lying imprisoned in the areolar structure of the broad ligament and the sub-peritoneal continuation of this structure, soon ceases to flow in consequence of the pressure of its enclosing walls; but in the second there is no such restraining influence, and consequently the hæmorrhage is more liable to terminate speedily in death.

Among the predisposing causes of these hæmorrhages are recognized first, a congested or inflamed condition of the uterus or of its appendages, induced or aggravated by habitual constipation, or by any cause preventing a free return of the blood from the pelvic organs; second, a hæmorrhagic diathesis; third, occlusion of, or obstruction of the vagina, uterus, or Fallopian tubes, forcing the menstrual and other blood back into the peritoneal cavity; fourth, extra-uterine gestation.

The exciting causes have been supposed to be: sudden suppression of a hæmorrhoidal discharge; straining to evacuate the bowels; violent muscular exertions; the concussion occasioned by falls; excessive venery and mental emotions.

Treatment.—The first variety cannot properly be considered as the subject of surgical treatment, since, if it were possible to recognize its existence during life, it is apparent that the remedy is already supplied in the encysted and circumscribed character of the hæmatocele. The second variety, with which alone a ruptured extra-uterine fœtal cyst can be confounded, might, also, in the opinion of Dr. Rogers, be submitted to the same treatment as that which he has suggested for the latter, namely, gastrotomy and the ligature (see Extra-Uterine Pregnancy); and, in view of the inevitably fatal result of both of these accidents without surgical interference, we see much reason for entertaining his suggestions with respect.

Atresia Vaginæ.

Congenital Atresia Vaginæ.—The vagina is subject to a variety of abnormities; thus it may be wholly absent, a condition which is often associated with absence of the ovaries and uterus; the walls may be in contact and slightly adherent, or the canal may be only closed at the outer extremity by a tegumentary or mucous diaphragm; the hymen may be imperforate and thickened; the atresia may be limited to the mouth of the womb, or to more or less of the central portion of the vaginal tube, in which latter case there will exist an upper and lower *cul-de-sac;* finally, the vaginal canal may terminate in the urethra, bladder, or rectum.

In case the canal is closed by a tegumentary or mucous diaphragm at or near the outer extremity, a simple crucial incision is all that is required; a piece of soft lint covered with cerate being introduced between the lips of the incision to prevent its closure; indeed this membrane is sometimes so delicate that it may be sufficiently torn by simply stretching the labia apart. When, also, slight adhesions exist along the course of the vaginal canal at birth, a probe will usually suffice to accomplish the separation; but in order to prevent their reunion, the introduction of a tent is indispensable.

When the mouth of the uterus is closed, or the central portion of the vagina, or an imperforate hymen is the cause of the obstruction, the defect generally escapes detection until the period of puberty. Although an operation at this period is greatly facilitated by the accumulation of the menstrual fluid above the point of obstruction, experience has shown that it is attended with peculiar hazards. It is desirable, therefore, in case the defect is recognized earlier, to secure an outlet in anticipation of the menstrual flow. The precise mode of procedure cannot in such a case be here indicated, since it must depend wholly upon the extent and seat of the obstruction. It ought to be stated, however, that when the obstruction is extensive and the operation for its relief is made before the period of menstruation, the operation is not only difficult, but it is still more difficult to maintain the canal in a patulous condition after the operation has been successfully made. When the obstructions are of the character last mentioned, and the period of menstruation has arrived without its having been recognized or relieved, the operator will select a day immediately following the menstrual nixus; when, the patient being placed in position as for the operation of lithotomy, a transverse incision is made upon the projecting tumor, or, in case no tumor presents, upon the centre of the depression which indicates the natural position of the outlet, and the dissection is carefully extended upwards, guided by the occasional introduction of a finger into the rectum or wound, and a firm steel probe in the bladder, until the fluctuating *cul-de-sac* is felt, when the operation may be completed by a trocar and canula. In one case I have felt distinctly the neck of the womb prior to the introduction of the trocar, and have been able to conduct the instrument into its open orifice.

The fluid contents being discharged, a long flexible catheter or a drainage tube must be introduced into the vaginal pouch, or the uterus, and maintained in place several days. If the canal is long and the upper orifice small it will be best to leave the silver canula undisturbed for the first three or four days, as it is sometimes difficult, having withdrawn the canula, to pass the flexible tube. At a later period the canal must be gradually enlarged by sponge tents.

The fatality of this operation, which has been considerable, has not seemed to depend in any degree upon the extent of dissection required to reach the cavity containing the menstrual fluid, since death has unimpaired, and as a thorough examination convinced me that the vaginal canal could not be re-established, and as the period was approaching when menstruation ordinarily ceases, I advised her to defer an operation until the necessity became more urgent. About one year later a surgeon attempted to open the vagina by incision, but failed. In March, 1856, I was again summoned to see her, and found her suffering greatly, the uterus being much enlarged and forming a distinct tumor both in front and in the rectum. With a curved trocar and canula, carried upon the index finger of my right hand, I punctured the uterus through the rectum, giving exit to a large amount of dark-brown, uncoagulated, inodorous fluid. Withdrawing the trocar, I was able easily to introduce my finger, and to enlarge the opening by tearing the thin and tender uterine walls. The relief was complete, no grave symptoms ensued, and for many years she menstruated through the rectum with comfort, and until the period of life at which menstruation ceased altogether.

By a most remarkable coincidence her only daughter, after her first childbirth, suffered the same accident from vaginitis, the vaginal canal becoming completely obliterated. Within a year from her confinement I was called to operate upon her, and found her as large as a woman at the full period of utero-gestation. I opened the womb through the rectum, as in the case of her mother, and evacuated a gallon or more of a light straw-colored fluid, which appeared to be serum mingled with pus and flakes of lymph. The issue was, however, not so fortunate. A low irritative fever followed, to which she eventually succumbed.

Abscess of the Labia.

In consequence of injuries, but most often as a result of repeated and violent coitus, occasionally in consequence of furunculi, the submucous and areolar tissue of the labia is liable to acute inflammation, which causes excessive pain and swelling and speedily ends in suppuration. In most cases the pus evacuates itself spontaneously into the vaginal canal between the labia. I have observed that an abscess having once formed in the labia, the patient is for some time after peculiarly prone to a recurrence.

Treatment.—Rest in the recumbent posture; emollient poultices and early incision.

Suppuration of the Vulvo-vaginal Glands of Bartholin.—Inflammation of one of these glands, ending in suppuration, is characterized by a small circumscribed swelling on the inner and lower portion of the labium, which usually discharges its contents by the most direct route, through the mucous membrane, but occasionally through the excretory duct within the labia minora. When the excretory duct alone is the seat of the inflammation the resulting abscess is oblong and situated farther back between the labia. In some cases the excretory duct forms a permanent sinus, requiring incision to effect a cure.

Noma of the Labia.

A phagedenic ulceration, ensuing upon an erysipelatous inflammation, sometimes attacks the labia in scrofulous and unhealthy children, resembling the cancrum oris described in another part of this treatise. The treatment is the same as for the affection last named.

Varicocele of the Labia.

The veins of the labia are occasionally enlarged and hypertrophied, especially in women who have borne many children. A compress supported by a bandage is the only treatment.

Encysted Tumors of the Labia.

I have already called attention to ovarian and other herniæ which occasionally present themselves in the labia, to hydroceles of the round ligament, encysted tumors of the round ligament, hydroceles of the pouch of Broca, and to labial hæmatoceles. Occasionally, also, we find in this region simple encysted tumors, formed in the substance of the labia, and which may have originated from a dilatation of one or more of the cells of the areolar tissue, or from obstructed muciperous or vulvo-vaginal glands. They seldom attain a greater size than a goose-egg. They are elastic and usually free from pain or tenderness. The treatment consists usually in a free incision of the sac, and the adoption of suitable means to encourage granulation. Complete excision of the sac is always difficult and rarely necessary.

Fibrous Tumors.

Fibrous tumors are sometimes developed in the labia and especially in the labia majora. They demand extirpation; and the operation can in general be performed by a species of enucleation. By keeping close to the tumor, and rather within some of its dense cellular investments, the bleeding will be much lessened, and fewer vessels will require the ligature.

Elephantiasis of the Vulva.

More often observed in tropical countries, but especially frequent in the island of Barbadoes, elephantiasis of the vulva is characterized by nearly the same phenomena which distinguish elephantiasis of the scrotum and of other portions of the body. Scanzoni observes, however, that "it is characterized by a great poverty of blood-vessels," in which respect, if the observation is correct, it differs essentially from elephantiasis of the scrotum. It seems also more prone to superficial ulceration.

Treatment.—Nothing worthy of repetition has been furnished by those who have had experience in this malady as to the principles which are to guide us in the treatment. General hygiene, moderate compression, support to the pendulous mass, and extirpation, are probably our only resorts.

Vegetations at the Orifice of the Urethra.

The mucous papillæ at the orifice of the meatus urinarius, in consequence of prolonged irritation, often become hypertrophied, forming irregular, sessile or pedunculated, vascular and wart-like tumors, varying in size from a pea to a hen's egg. In some cases they arise from within the orifice of the urethra, and in others they are wholly external. If permitted to remain they are prone to involve the mucous tissue more extensively, and finally they may invade even the tegumentary tissue.

When occurring in early or middle life, these growths are generally of a benign character; but I have seen frequent examples in advanced life which have eventually formed intractable ulcers; and in some they have degenerated into cancroids, which have only terminated in the death of the patients.

Treatment.—Early and thorough excision is the most satisfactory remedy. When very small it is generally sufficient to excise the papilliform growth with scissors, and then touch the wounded surface with a stick of nitrate of silver. When more extensive it is necessary, to insure a complete cure, to remove with the tumor a small portion of the adjacent mucous membrane, closing the wound subsequently with sutures.

Cancroids and the Several Varieties of Cancer.

Cancroids and all the other varieties of malignant growths occasionally attack the labia and the vaginal walls, as primary affections. Their treatment is subject to the same rules as govern the treatment of these maladies elsewhere.

Hydrocele in Women.

The peritoneal process which accompanies the round ligament through the external abdominal ring of the female, called the ligament or canal of Nuck, may become the seat of hernia not only, as has already been explained, but like its analogue, the peritoneal process of the male, it may become the seat of hydrocele, and this form has been appropriately named "Hydrocele of the round ligament." In the areolar tissue adjacent to the round ligament are also sometimes formed adventitious cysts, termed "encysted tumors of the round ligament." Moreover, the canal of Nuck may be prolonged by the descent of a hernia into the pouch of Broca; and in like manner, or as a sequence of hernia, a hydrocele may form in this sac, occupying the labia majora, the tumor corresponding anatomically to the hydrocele of the tunica vaginalis in the male; or, finally, adventitious cysts may form in the labia, corresponding in some sense to the encysted hydroceles of the tunica vaginalis of the male.

Diagnosis and Treatment.—The diagnosis may be inferred from the position occupied by these tumors, by a reference to what has been said of their congeners in the male, and to the remarks made upon inguinal hernia in the male. The treatment is essentially the same as for their analogues in the male.

Urinary Fistulæ in the Female.

These fistulæ may be caused by the long-continued pressure of the head of the child in natural labor; by the unskilful use of forceps and of other instruments in artificial labor; by a rupture of the inferior portion of the uterus or vagina, when pelvic, vaginal, or uterine obstructions exist which offer unusual resistance to the passage of the child; by syphilitic and cancerous erosions, and by various other diseases or local injuries.

The fistulæ may be urethro-vaginal, vesico-vaginal, urethro-vesico-vaginal, vesico-uterine, vesico-utero-vaginal, vesico-uretero-vaginal, or uretero-vaginal; and to these may be added, according to the statement of some gynæcologists, uretero-uterine.

Since the introduction of the modern improvements in the treatment of these various forms of fistulæ, we no longer class them among the *opprobria chirurgica*, or consider any other modes of treatment than such as propose a radical cure. Thanks to the genius and labors of such men as Bozeman, Sims, and Emmet, of our own country, and of Baker Brown, Simon, and others abroad, I believe we may declare that nearly every form and degree of urinary fistulæ is susceptible of cure; or at least we are permitted to say that nearly all cases may be either radically cured by occlusion of the vesico-vaginal or vesico-uterine aperture; or they may be greatly relieved by some one of the various ingenious surgical devices now practised, including the palliative operation termed "kolpokleisis."

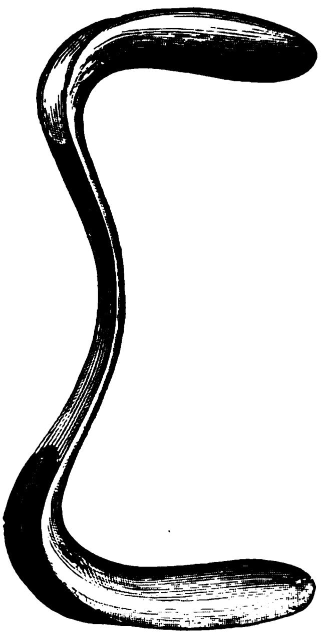
Preparatory Treatment.—A certain proportion of cases are complicated with more or less complete occlusion of the vaginal canal, or other abnormities, which require to be relieved before the operation for the closure of the fistula is undertaken. In other cases no other preparatory treatment than attention to the condition of the general health is necessary.

Sims and Emmet's Method of Operating for Urinary Fistulæ.

Both of these gentlemen adopt essentially the same plan of treatment in these cases; and I have condensed from their published statements the following brief summary of their practice:—(For more complete details, relating especially to certain modifications of instruments and of procedure, adapted to the exigencies of particular cases, the reader is referred to Dr. Emmet's treatise on vesico-vaginal and recto-vaginal fistulæ.)

The instruments required for this operation are specula, Emmet's modified Sims' tenaculum, and Perry's barbed tenaculum, a blunt hook, scissors of various forms and sizes, a universal-jointed knife, needles, needle forceps, a "feeder," forceps for securing the wire in the silk loop, twisting forceps, a shield, and, in addition, several sponge-holders, silver wire, silk thread, two block-tin catheters, and sponges. When the operator can command intelligent assistants, Sims' speculum is probably the best instrument; but for cases in which reliable assistants cannot be obtained, and in which the operation is likely to be greatly prolonged, Dr. Emmet has constructed a self-retaining speculum which may conveniently be substituted. Emmet's and Perry's tenacula are used in holding the tissues while denuding the edges; the blunt hook is an exploring instrument, and it is also useful in searching out and lifting embedded sutures. The needles should be from one-half to three-quarters of an inch in length, round, largest at the eye, countersunk to receive the thread, and slightly curved near the point. The "feeder" is used for guiding the suture and preventing any strain upon the tissues in its transit from one side of the fissure to the other. For the purpose of securing the wire in the silk loop, common forceps will answer. The twisting forceps and the shield are employed in adjusting, holding in place, and twisting the wire home. The shield should be made of a single piece of plated copper, so that its angle may be changed if necessary.

Fig. 451.



Sims' Speculum.

Wire made from virgin silver is generally employed; but the best quality of iron wire is quite equal to wire made from coin silver, which is the kind usually found in the shops. Nos. 28 and 29 are the sizes required. A sigmoid, self-retaining catheter, made of block-tin, in order that its curve may be changed at pleasure, is employed by Sims and Emmet. Both of these gentlemen now generally place their patients upon the left side, with the knees well flexed upon the abdomen, the left arm thrown behind the back, with the face and chest inclined forwards toward the table.

The edge of the fistula being seized with the tenaculum, a continuous strip is removed with the scissors, taking care not to include any portion of the mucous membrane of the bladder. The needle, armed with a loop of silk thread, is then introduced upon the sound vaginal membrane and brought out so as not to include the mucous membrane of the bladder. On the opposite side of the opening the same care is taken not to include the interior surface of the bladder in the suture. In the passage of the needle, the surgeon is aided by the tenaculum and forceps. At least from four to five sutures are required to the inch; and one or more should be passed at each extremity beyond the fistula. As each silk suture is passed, a piece of silver wire is hooked upon its loop and drawn through, and at the same time the left-hand extremity of the wire is passed through a loop or slip-knot previously made in the right-hand extremity. When all which are required have been introduced, the left-hand extremity of the first wire is drawn forwards until the slip-knot is about three-quarters of an inch from the wound, when the knot is seized by the twisting forceps and the excess of wire cut off. Still holding upon the loop, by the aid of the blunt hook the wire is shouldered, or bent on each side at a right angle toward the fissure. With the shield the two strands are now embraced close to the surface of the wound, and the wire is twisted carefully until the adjustment is complete. The shield being withdrawn, a tenaculum, used as a fulcrum, is placed against the wire close to the fistula, and with the twister the wire is bent over. By pressure with the hook, the wire is again bent toward the mucous membrane close to the forceps, and cut off where the last angle is made; this will be about half an inch from the wound.

When the operation is completed the patient is turned upon her back, a catheter introduced, and, if the urine discharged is bloody, the bladder is well rinsed with tepid water; the patient being required to remain upon her back, if possible, until the sutures are removed. The catheter is then withdrawn and cleansed, and thereafter this is repeated several times each day. Opium may be given in sufficient quantity to maintain constipation. The sutures are usually removed from the eighth to the tenth day, but the catheter is permitted to remain a few days longer.

Bozeman's Method of Operating for Urinary Fistulæ.

We have given to the method of operating first devised and practised by Dr. Nathan Bozeman, of this city, more space than has been given to either of the preceding methods, not because we intend to declare for it a preference, but for the reason that, while in his hands it has proved at least equally successful as other modes, and equally adapted to the various forms of vesical fistulæ, to him especially is due the credit of having first demonstrated the practicability of effecting a cure in a large proportion of these unfortunate cases.

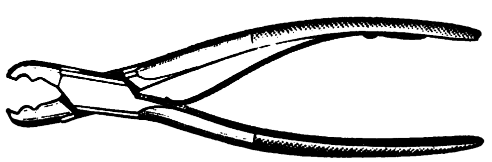
Most of the details of the mode of procedure adopted by Dr. Bozeman have been derived from my own personal observation of his operations, and from various communications which he has kindly placed in my hands.

The distinctive characters of Bozeman's operation are: the *button-suture*, the *position of the patient*, and the *self-retaining speculum*.

The *Button-suture*, invented May, 1855,[1] combines in principle the interrupted and twisted sutures, and is peculiarly adapted to lesions of mobile partitions, such as the vesico-vaginal or recto-vaginal septa.

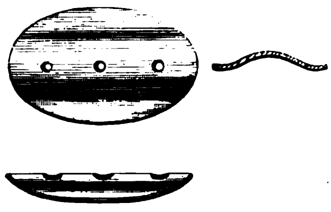
The silver wire used is No. 26, pure and well annealed; the leaden disk is $\frac{1}{20}$ of an inch thick and $\frac{5}{8}$ of an inch wide, of length and shape to fit the part; arched beneath, and bevelled at the edges. Perforated shot No. 3 secure the whole in place. The button, cut in the desired shape, is then moulded by Bozeman's forceps (Fig. 452)[2] into a saddle, over the fistulous edges, which are drawn up into its arch by the sutures, passing through holes $\frac{1}{3}$ of an inch apart along the middle. (See Fig. 453.) The sutures, first introduced, determine the length of the button and the number of holes to be made. The length in Fig. 453 is 1 inch. It is adapted to a fistula $\frac{7}{8}$ of an inch long.

Fig. 452.



By arching the button, the fistulous edges are drawn out of the direct line of strain upon the sutures, while a steadier support and more secure protection than the interrupted suture alone can give, increase the chances of success. The denuded borders are placed in the conditions of a subcutaneous wound and enjoy the same facility of reparation.

Fig. 453.



Before attempting to close the fistulous orifice, the normal width should be restored to the vagina. Bridles, bands, and adhesions of its walls, whether partial or complete, should all be overcome. Weeks, even months, of perseverance may be needed. This dilatation of the vagina gives time for its abrasions to heal. Its bridles are divided in the directions of greatest resistance, with care not to open the peritonæum or to compromise the urethra, bladder, or rectum farther than they may be already involved. To prevent contraction and reunion of the divided parts, Dr. Bozeman uses an oiled-silk bag stuffed with sponge, which is kept firm by tying up the mouth, and removed every day to be cleansed with carbolic acid or with solution of chlorinated soda. The bag itself gets rough and must be renewed every second or third day. The raw surfaces are encouraged to cicatrize by brushing them with a solution of arg. nitr. ʒ i. ad aq. ℥ i. freely applied, which affords great comfort to the patient.

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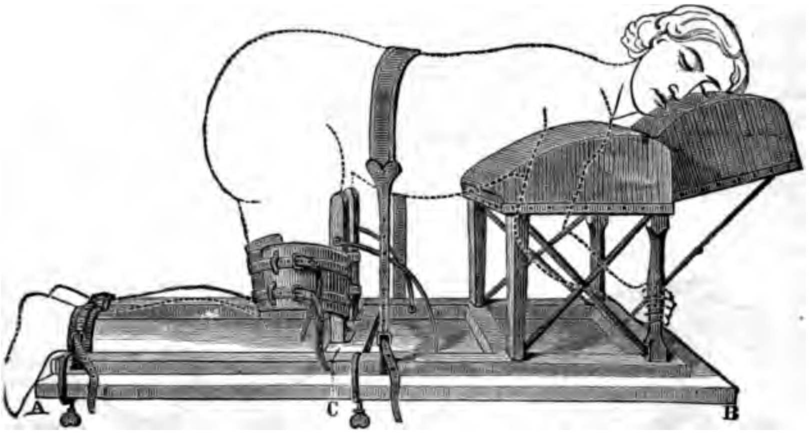
[1] *Louisville Review*, May, 1856.

[2] *New York Medical Journal*, p. 493, February, 1869.

Position of the Patient.—The knee-elbow position, once exclusively employed by Dr. Bozeman, has been renounced by him on account of its fatiguing both patient and assistants; and the danger incurred in giving anæsthetics while the body is thus inclined forward at an angle of 45°, with the viscera pressing on the diaphragm and lungs. For the knee-elbow Dr. Bozeman has substituted the knee-chest, or right-angle position upon knees and chest. I have several times seen him demonstrate the advantages of this position.

Fig. 454.



Bozeman's Knee-chest Position.[1]

By this arrangement the patient is made comfortable, and perfect steadiness is maintained without the aid of assistants. The apparatus is secured to the table A B, by four thumb-screws. When not in use, it folds at the joint C, while the upright thigh-pieces, disengaged from the braces, fall forward. The head-support, unbraced, drops, and is turned under the chest-support, to which a hook fastens it; both then stand back to back, so that the apparatus looks like an ordinary chair. Its weight, fixtures included, is 17 pounds. The patient is no more exposed than for introducing the speculum. An india-rubber cloth protects her dress, as well as the pads and straps.

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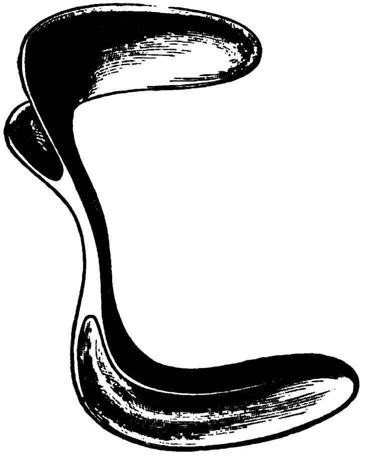
[1] *New York Medical Journal*, February, 1869.

The advantages of this knee-chest apparatus are:—"Extension of the vertebral column with relaxation of the abdominal muscles, permitting the forward gravitation of the viscera; support and confinement of patient, with control of her muscular action at certain points, without abdominal pressure, embarrassing neither the breathing nor the circulation; and safe anæsthesia."[1]

Fig. 455.



Self-retaining Speculum. — Dr. Bozeman at first modified Sims' speculum (Fig. 455) by shortening its handle, narrowing the heel of the blades or valves, as compared with their point, and inclining the blades towards each other at an angle of about 75° instead of 90°, as seen in the Sims pattern. Still he found it inadequate to the complete dilatation of the vagina, and exposure of the fistulous edges, when concealed by contractions of the vaginal walls, or by their voluminous folds. To obviate these difficulties, while dispensing with aids, Dr. Bozeman contrived a speculum made self-retaining by the *flaring of its blades within the pelvis*. Fig. 456[2] gives a three-quarter view of this speculum closed, and shows the under surface of the detached perineal blade, one-third the size employed.

Fig. 456.

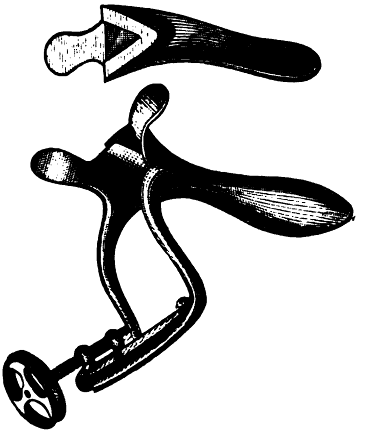
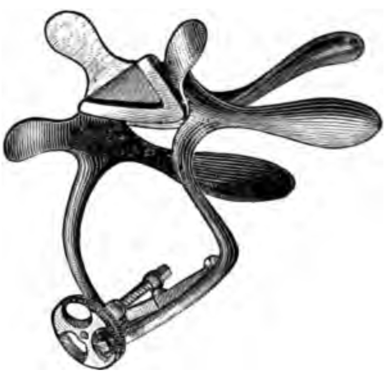


Fig. 457.



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[1] *New York Medical Journal*, Feb., 1869, p. 486.

[2] *The Medical Record*, Jan. 1, 1868, and *New York Medical Journal*, Feb., 1869.

Fig. 457 shows the self-retaining speculum expanded, with the perineal blade *in situ.* The anterior vaginal wall and cervix uteri are thus completely exposed. Aid is only needed to administer an anæsthetic and to wash the sponges. A speculum of the size indicated answers for most cases. Dr. Bozeman occasionally uses a smaller or a larger size. Instead of the detached blade, he sometimes passes between the blades of the speculum and against the posterior vaginal wall a spatula-shaped *perineal elevator* (Fig. 458), by which the surgeon can dilate the vagina to its limit. This elevator is useful in dividing contractions and in removing the suture apparatus. By the little connecting screw (*a*) the blade may be set in four different positions, adapting it to both vaginal walls in the two positions of the patient

458.

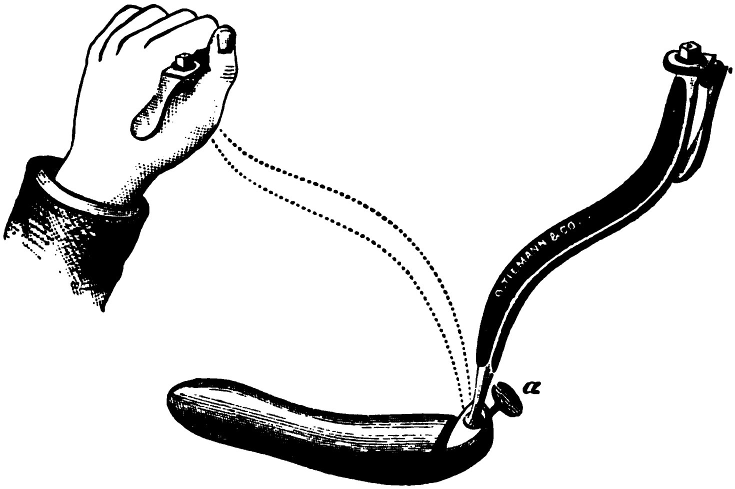

Fig. 459.

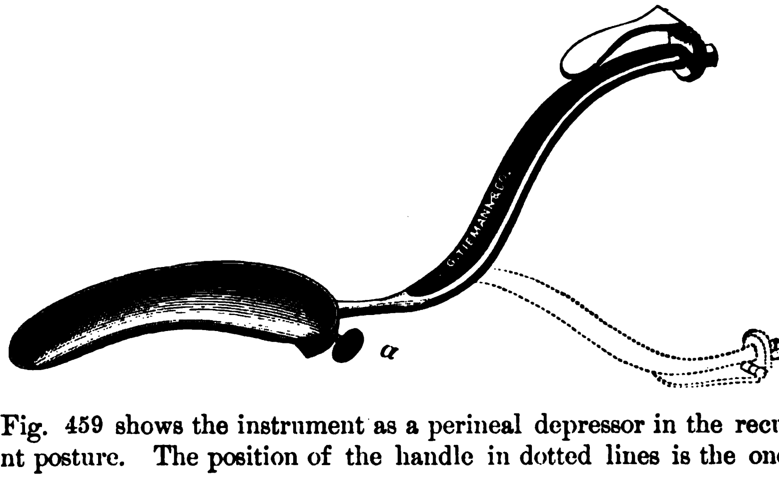

Fig. 459 shows the instrument as a perineal depressor in the recumbent posture. The position of the handle in dotted lines is the one it assumes when the blade is turned against the anterior vaginal wall. When the handle is detached from the blade both may be carried in the vest pocket.

Operation.—*First step: Paring and Shaping the Fistulous Edges.*—The instruments needed are a pair of delicate tenacula, a pair of straight knives, delicate curved forceps, a blunt-pointed knife, a pair of right and left angular knives (all narrow and delicate), and a pair of right and left curved scissors. Also, half a dozen sponge-holders, with sponges, water, etc., close at hand.

In shaping the edges of the fistula, Dr. Bozeman's rule is to make the line of union transverse to the vaginal axis. He aims to approximate them with the least possible traction upon the sutures, by the accommodating descent of the uterus. Lacerations or slits of the urethra at its outer extremity, or in its continuity; lacerations of the upper part of the vagina, complicated with rents of the anterior lip of the cervix uteri, and vesico-uterine fistulæ, are varieties, the paring of which should be effected with a view to their closure lengthwise. When two small fistulæ, or a small and a large one, are separated only by a narrow slip of tissues of no special importance, this is to be sacrificed. When the anterior lip of the cervix uteri forms the whole or a part of the posterior border of a fistula, it is pared and shaped like any other part of the vesico-vaginal septum. When the cervix uteri is turned into the bladder and confined there by adhesions, the paring is still confined to the anterior lip. To bring this lip on a level with the front edge, the original fistula is enlarged just beneath by incisions to right and left, through the whole thickness of the septum. By this means the anterior border of the fistula is relaxed, and a view obtained of the anterior lip of the cervix uteri, which, with the newly-formed edges of the fistula, is now pared and shaped, with intent to disengage it from the bladder and to close the fistula permanently.[1]

Unless the cervix uteri be involved, the fistulous borders are always bevelled on the vaginal side of the septum. To secure the best coaptation in this case, the border should be perpendicular, as is required by the hard unelastic tissue of the cervix uteri.

Vesico-uretero-vaginal and uretero-vaginal fistulæ[2] require, besides bevelling, to snip off with a scissors a bit of the vesical mucous membrane opposite the end of the ureter. If, however, the ureter can be seen, a delicate curved bistoury may be introduced and passed up the canal a quarter of an inch. It will thus pierce the side next the bladder, along with the vesical mucous membrane, when this is brought down, dividing the whole to the edge of the fistula. The object is on the one hand to guard against complete coaptation of the edges of the vesical mucous membrane opposite the point at which the urine passes from the ureter into the bladder, and, on the other, to oppose the tendency of the urine to escape between the edges of the fistula into the vagina, casualties either of which might compromise the operation. Still more to be dreaded is the complete obstruction to the flow of urine in any direction, which has proved a cause of death in one case at least. In all very large fistulæ, the superior fundus of the bladder tends to protrude into the vagina and thus conceal the edges of the fistula. Such abnormal conditions are liable to occur from bearing down, whether voluntary or involuntary, as in vomiting, etc. This obstacle is overcome by means of a large sponge, introduced through the fistula into the bladder, so as to support the protruding part. When the paring is completed and the sutures introduced, the sponge is removed. Hæmorrhage is checked by ice-water sponging, or by the application of ice directly to the bleeding surface. If this fail, we must find the divided artery and make torsion. Finally, a ligature may be provisionally attached, until the adjustment of the sutures controls the hæmorrhage by compression. The operation cannot be finished while hæmorrhage is at all active, because, however' complete the closure on the vaginal surface, blood may be escaping into the bladder, and, choking up the catheter, causing involuntary vesical contractions and so compromise the result.

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[1] *North Am. Med.-Chir. Review*, July and Nov., 1857.

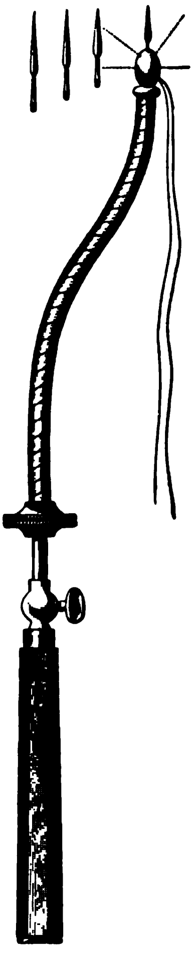
[2] Op. cit., *and Am. Journal Med. Sciences*, July, 1870.

Second step: Introduction of the Sutures.—The instruments necessary for this purpose are six straight spear-pointed needles, from half an inch to one inch and a quarter long, and a few curved ones suitable for insertion about the cervix uteri; a needle-holder, a blunt hook, and a long pair of curved forceps with copper-plated points for seizing and pulling the needles through.

Bozeman's needle-holder (Fig. 460) has a long, curved shaft with a clasp, in which the needle is held at the required angle by a flexible canula, which slides up and down, to fasten and to disengage it. Dotted lines depict the varied angles at which needles may be set. One, armed with silk thread, is shown as clasped for use.

Commencing usually on the right side, the needle is inserted from one-quarter to one-third of an inch from the pared surface, passed along the tissues of the septum, and is made to emerge just beneath the vesical mucous membrane, where it is caught upon a blunt hook, seized by the forceps and drawn through. In like manner the needle is inserted upon the opposite side of the fistula, the thread emerging at a corresponding point. Thus transfixion of the vesical

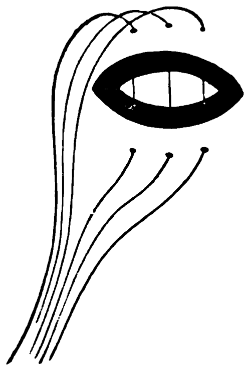
Fig. 460.



mucous membrane is entirely avoided. The stitches are placed one-third of an inch apart.

To the proximal end of each silk thread, a silver wire 18 inches long is attached, and drawn through to replace the silk. To facilitate this manœuvre, the distal end of the thread is supported upon the end of a fork, which prevents dragging or arrest of the knot. Fig. 461 shows the extent of the bevelling and the sutures in place.

Fig. 461.



The apposition of the edges of the vesical mucous membrane cuts off all communication between the cavity of the bladder and the tracks of the sutures. When the cervix uteri is incarcerated, after making the necessary incisions and paring, and the sutures having been introduced as above mentioned on either side, three will usually be taken in the cervix uteri itself. A needle, passed as usual through the anterior border of the fistula, is clasped by the needle-holder at an acute angle. Thus armed, the instrument is carried through the fistula into the bladder, and the point of the needle enters the front of the pared surface upon the anterior lip of the cervix uteri. The needle is next brought through from before backwards, its point coming out in the os tincæ. One suture is made on either side of it and one in the centre, these three sutures being placed at $\frac{3}{16}$ of an inch apart.

By the silver wires which replace the threads a leverage is obtained over the cervix uteri, by which it is lifted out of the bladder to the point at which its pared surface becomes level with that of the anterior border of the fistula. When lengthwise closure is required, as for the urethra and cervix uteri, sutures are passed from right to left, instead of from below upwards.

Third step: Adjustment of the Sutures.—Fig. 462 shows Bozeman's suture adjuster in a front and edge view, with the small hole in the centre, through which the two ends of each wire are successively passed. The instrument is then slid down upon them, and, on reaching the vaginal surface, it closely approximates the pared edges, as shown (Fig. 463). The loop in each suture generally remains until such adjustment. The line of contact shows whether the edges have been fitly pared, and suggests the shape of the button required. If the edges look uneven, open the loops and perfect their paring, taking care to cut no suture. On readjustment, if the coaptation be complete, cut the button or leaden plate of the proper size and shape, mould and perforate it as described.

Fourth step: Fastening of the Sutures and Button.—Fig. 464 shows

ster, with which use a strong pair of forceps to com-
Pass the ends of each wire through the holes in the but-
en hold between the thumb and index-finger of the left
all the wires, while the right hand, with the suture ad-
button down to its place. Fig. 466 shows the button
he perforated shot upon the wires, ready to be slid
top, where they are successively compressed by the

Fig. 464.

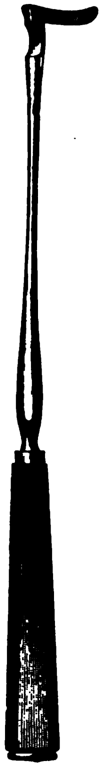


Fig. 463.

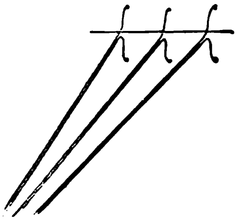
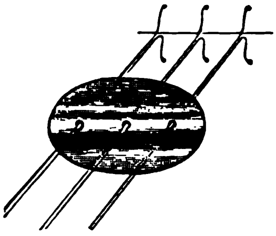


Fig. 465.



secured, the wires are cut off an eighth of an inch
, and turned down, completing the operation. (Fig.

implest form of button suture applicable to small and
istulæ, anywhere between the root of the urethra and
. Modifications will of course be required in indi-
before indicated, the success being in proportion to
erstanding of the conditions. The cuts, Figs. 468[1] to
s suture as applied in typical cases by Dr. Bozeman,

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[1] *Louisville Review*, May, 1856.
[2] *Trans. New York State Medical Society*, 1869.
[3] *Am. Jour. of Obstetrics*, May, 1870.

viz.: Fig. 468 depicts the button for lacerations of the urethra upwards from the meatus.

Fig. 466.

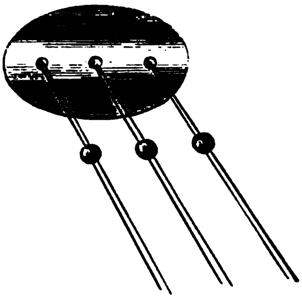
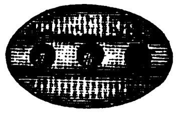


Fig. 467.



The button-suture claims precedence over every other in raising and supporting the catheter, always an elastic one for these cases, and not larger than No. 6.

Fig. 468.

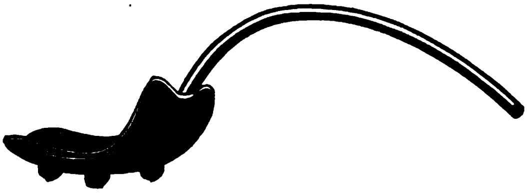


Fig. 469 gives front and side views of a button applicable to a small fistula in the urethra near its commencement. The sutures are two on either side of the urethra.

Fig. 470 gives front and side views for a longer fistula, involving the urethra and bladder (urethro-vesico-vaginal). The side view shows the button bent upon its convexity.

Fig. 469.

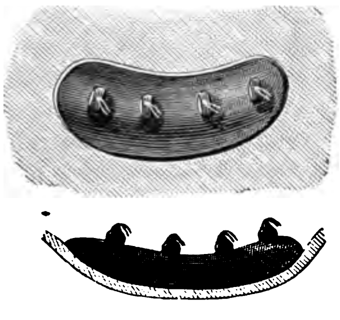


Fig. 470.

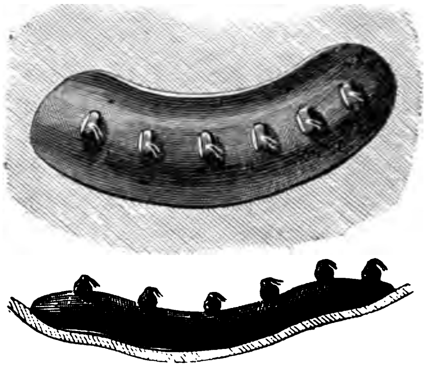


Fig. 471 depicts the button for a large fistula involving the trigone and *bas-fond* of the bladder. Such a button, either curved or straight, and notched in its upper edge for the accommodation of the cervix uteri, is applicable also to vesico-utero-vaginal fistulæ of large size, whether simple or complicated. In the latter the curved form is generally required, to hold the cervix uteri in its proper position after it has been disengaged from the bladder, and until union can be effected between its anterior lip and the lower edge of the fistula, thus cutting off communication between the bladder and uterus, and restoring the natural outlet to the menstrual flow. A button (Fig. 472), nearly straight, but narrowed at the upper end, so as to rest within the os uteri, is usually called for in fistulæ complicated with laceration of the anterior lip of the uterus. Such a form is also applicable to vesico-uterine fistulæ, either alone or associated with vesico-vaginal.

Fig. 471.

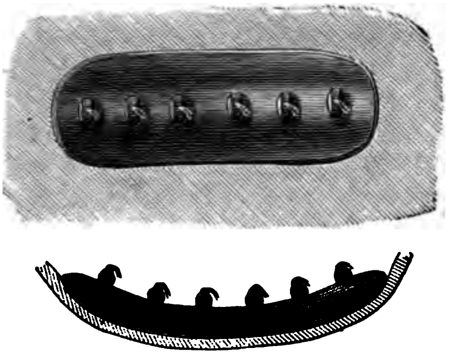
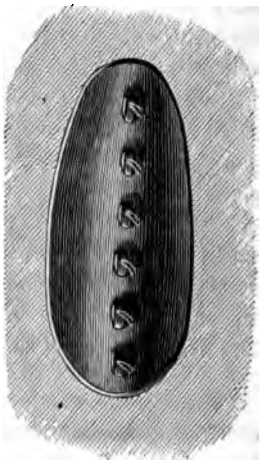


Fig. 472.



After-treatment.—Let the patient lie on her back, but allow her to change her position now and then to either side. An elastic catheter in the bladder drains its contents into a small flat-bottomed box, which serves also to hold the catheter in place. Half a grain of morphine or less may control the movements of the bowels and relieve pain.

Frequent attention must be given to the urinal, and still more to the catheter, which is liable to become choked and to compromise the success of the operation by allowing urine to accumulate within the bladder. Water should be occasionally injected through the catheter as a precautionary measure. Should there be any vesical hæmorrhage, this injection will prevent the blood from clotting, and if iced, will check its flow. This method has proved more reliable than the ordinary astringents, although it does not always obviate the necessity of making direct pressure, at the cost of removing the suture apparatus; cleaning out the bladder through the fistula, and pressing the tip of the finger upon the bleeding orifice; foregoing the operation *pro tempore*, to save the patient's life. Replace the catheter by a fresh one about the fourth or fifth day, as it may have become a little rough. Use vaginal injections once or twice a day, taking care not to touch the suture apparatus with the syringe nozzle.

The diet should be light and rather constipating, such as tea or coffee, and fine wheaten bread, with beef-tea used discreetly. The sutures should be removed on the eighth day, or, in operations involving the urethra alone, on the seventh day. In removing the sutures, the patient must be placed in the knee-elbow position, without anæsthesia. If the suture apparatus be low down in the vagina, Dr. Bozeman employs his perineal elevator alone for exposing it; but if higher up, his speculum, carefully avoiding a dilatation dangerous to the tender cicatrix. Seizing each shot with a pair of forceps, and raising it slightly, he clips it off with the points of the scissors, and then lifts the button by the forceps from its position. The loop of each suture being now opened, its proximal end is seized, and the wire gently extracted. The patient is now put to bed, and treated as before. She wears the catheter two or three days longer, it afterwards being introduced only at regular intervals. She may sit up on the twelfth, leave her bed on the fourteenth day, and then, for the first time, void her urine through the urethra.

Incurable Urethro-vaginal and Vesico-Vaginal Fistula.

The destruction of the urethra and urethral portion of the vagina with the vesico-vaginal septum, finds an expedient of partial relief in the closure of the vulva, as proposed by Vidal de Cassis. In the preliminary paring of the labial mucous membrane, care must be taken to leave a small passage at the upper angle for the escape of urine, when the pouch above is filled. This operation, however, only enables the woman to retain the urine when reclining upon the back, and does not secure any control over the urine in the erect posture. The barrier formed by this operation has no contractile power.

Another class of cases presents the less grave disaster of partial or complete destruction of the vesico-vaginal septum, either alone or associated with injury of the root of the urethra, below; and of the cervix uteri above, with immobility of the womb. Here Dr. Bozeman's expedient[1] is to close the urethral portion of the vagina at the lower border of the fistula, by uniting the latter with the posterior wall of the vagina, thus converting the remains of the bladder and the vagina into one receptacle for the urine and menses, with the urethra as a common outlet. This is effected with the button-suture, according to the rules already given. By adopting this mode of procedure, no pouch or pocket is formed in the vagina where urine can stagnate or stone accrete.

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[1] *New Orleans Medical and Surgical Journal*, January, 1860.

Recto-vaginal Fistula.

Fistulæ of this kind, whether due to injury of the parts during labor to wounds of the rectum, or to abscesses breaking into the vagina, are liable to great variations. Their openings may be found at or above the sphincter ani, and no larger than an ordinary probe, or they may lie at any point between this and the reflection of the peritonæum from the vagina upon the rectum. Their size and shape vary indefinitely, involving sometimes the perinæum and the entire recto-vaginal septum.

When the fistula enters the rectum at a point which involves the sphincter ani, it is idle to attempt to contend with the contractions of the latter by the application of sutures; at least not until the sphincter has been paralyzed by incisions or stretching; and even if this were done, it would be better to extend the opening by incision down to the perinæum, pare the edges of the original fistula, and then close, as in an ordinary case of ruptured perinæum.

Much greater facility is experienced in operating when the fistula is entirely above the sphincter, but in these cases also the operation may be rendered more easy by first paralyzing the sphincter. When this operation is made, the line of closure must be transverse.

Laceration of the Cervix Uteri.

According to Emmet, this is a very common accident, having been observed by him in more than thirty-two per cent of all the cases of uterine diseases which have come under his observation in those women who have borne children; and as the lesion has been observed more frequently where the forceps have been employed, it is fair to assume that it occurs much more often now than formerly, or than it did at that period when most women were able to give birth to their children without the aid of instruments.

As a consequence of the persistence of the laceration, the edges are liable to take on an irritable ulcerative action, leading to induration and hypertrophy of the neck, and indirectly to functional disturbance of the neighboring organs and of the whole system.

In a large majority of cases, absolute cleanliness, by the frequent use of warm water lavements, will be sufficient to insure a prompt cicatrization; and at a later day, when an ulcerative action has been for some time established, the same plan of treatment, with the occasional application of the nitrate of silver, will in most cases effect a cure. In case, however, it does not, it will be proper to operate in the manner first suggested and practised by Emmet. The patient being placed under the influence of an anæsthetic, the uterus is drawn down by a tenaculum, the edges of the rent carefully excised, and then closed by silver sutures. In no case ought the operation to be attempted while the parts are in a condition of active inflammation. If much bleeding occurs from the congested tissues, it is best controlled by injections of hot water; but if the cervical artery is cut, it may become necessary to cast a ligature of wire around the neck, close up to the insertion of the vagina. Having secured the ligature by twisting, it is to be left in place until the danger of further hæmorrhage has ceased. The parts must be kept clean subsequently by frequent warm-water injections. The sutures are not to be removed until the seventh or tenth day.

In estimating the value of this operation, it is necessary to recall what has already been said as to the curability of this affection by the unaided resources of nature, or by well-directed therapeutical and local treatment, and also to understand that although the ulceration, hypertrophy, etc., may be the source of serious constitutional disturbance, it seldom, if ever, proves fatal. On the other hand, the operation is not always successful; it is attended with the danger of sometimes giving rise to a serious and even fatal metritis and perimetritis; and the laceration is pretty certain to be renewed in a succeeding labor.

Laceration of the Perinaeum.

This accident is of quite frequent occurrence, especially in the birth of the first child. It is unjust to say that it can always, or even generally, be prevented by the skill of the accoucheur, since its occurrence is often due to conditions and circumstances over which the accoucheur has no control. The perinæum may be unusually deep in its antero-posterior diameter, or unusually thin and delicate, or less elastic in its texture than natural; the sacrum and coccyx may not have the proper curve to direct the head toward the pubes; the head itself may be large and unyielding; the uterine contractions may be too violent and rapid to allow the perinæum time to become gradually stretched and accommodated to the head. Indeed, there are many causes which may determine this result which are wholly beyond the power of the accoucheur to remove.

It is no part of my duty in this place to indicate what are the means usually employed by obstetricians to prevent its occurrence, but I may be permitted to say that, if the obstetrical experience of my early life, and the surgical experience of my later life, have not misinformed me, grave perinæal lesions are more common now than formerly, and this increase has been coincident with the increased use of forceps and of anæsthetics in labor. I mention anæsthetics in this connection, because the forceps and anæsthetics are so often associated in modern practice. The effects of anæsthetics are by no means in all cases limited to the alleviation or abolition of pain when employed in the case of the parturient female. In most cases they exert a positive influence upon the uterine contractions, and in this respect they are capricious. Not infrequently they increase the rapidity and strength of the contractions, and this is especially apt to happen when given in small quantities and in the first period of their exhibition ; it is under these circumstances that they may contribute to the production of a perinæal rupture. In other cases, under their influence I have seen the uterine contractions temporarily suspended, and a degree of uterine inertia induced which continued to the close of the labor, and which has been accepted by me in more than one instance to explain the delay in the expulsion of the placenta, and the subsequent uterine hæmorrhages.

While there can be no question that the forceps and anæsthetics have been of incalculable service to parturient women, I have a strong conviction that, since they have come into such common and almost universal use, they have done a great deal of harm. I believe that the time is not distant in the future when it will become apparent to all that we have in these matters progressed too rapidly, and possibly that our progress has been altogether in the wrong direction.

In a large proportion of cases the rupture is slight, involving only the fourchette, or only the mucous membrane which has been thrust beyond the fourchette. In exceptional cases it involves a large part or the whole of the perineum, and still more rarely it extends directly, by laceration, or by subsequent sloughing, through the sphincter ani, and more or less extensively destroys the vagino-rectal septum.

In the simpler form of these accidents, where only the fourchette is torn, no serious injury is inflicted, and no surgical treatment is demanded. If left to itself, and some care be taken to keep the parts clean, it may be restored to its original condition by the unaided process of cicatrization ; but if it is not thus restored, no future inconveniences to the patient will ensue. Indeed this partial loss of perineum may render any further laceration in subsequent deliveries less probable.

In case, however, the laceration involves any considerable portion of the perinæum, extending nearly, or quite, to the outer circumference of the sphincter ani, the closure of the rent is desirable, inasmuch as in a certain proportion of cases it is followed by a relaxation and falling of the vaginal walls, with a consequent displacement of the uterus. But it has often happened to me to see women, in whom the rent has extended through the entire perinæum, who have, after the lapse of many years, suffered no inconvenience from this source. Especially has this been observed in the persons of spare women, and if they have not subsequently borne children.

The concurrence of a deficient perinæum, and of prolapsus uteri, do not always stand in the relation of cause and effect. The perinæum in its most perfect condition, and when the uterus occupies its normal position, gives no direct support to the latter. The uterus may be made to descend from many causes, whether the perinæum is sound or not ; and if, in its descent, it has been brought into actual contact with the perinæum, the presence of the latter is an important obstacle to its further protrusion. The absence of the perinæum, when the vagina and uterus are in their normal conditions, can only influence the descent of the uterus by first inducing atony of the muscular fibres of the vagina, with congestion and prolapse of the vaginal walls, by which not only the feeble and indirect support which the perinæum gave to the uterus is removed, but the vaginal walls become actually a dead weight to drag the uterus downward. These consequences to the vaginal walls and to the uterus, I am prepared to reaffirm, do not always ensue upon the total destruction of the perinæum. Although, if the woman subsequently bears children, or is very fat, they are liable to ensue.

Immediate or Primary Operation.—I cannot agree with some modern gynecologists, that it is better in such cases to proceed at once to close the rent by sutures, and for several reasons, some of which have already been anticipated. The parts have suffered such a degree of stretching and contusion as to render the occurrence of inflammatory reaction, if not of sloughing, almost inevitable; the lochial discharges will make it impossible to keep the parts clean; the operation itself inflicts a severe injury when the condition of the patient is already critical from other causes; and finally, because under judicious management the rent frequently becomes partially and sufficiently closed spontaneously.

If spontaneous closure of any portion of the rent takes place under these circumstances, it is probably not usually effected by the direct contact and immediate adhesion of the lacerated surfaces. The conditions are all unfavorable to this occurrence. Lacerated and contused wounds seldom unite by first intention, and the torn edges are too narrow and irregular to be placed and maintained in exact apposition, even with the aid of sutures. The surgeon encounters sufficient difficulty in securing this result even when, at a later day and under much more favorable circumstances, and after an extensive denudation of the surfaces, he attempts the closure by the aid of sutures. It is much more probable that the union occurs in these cases by the secondary process of granulation, the cicatrization and restoration commencing at the angle of the wound where the laceration terminated, and extending thence in the direction of the vaginal orifice. This is what happens usually in the case of a lateral incision, made for the purpose of enlarging the orifice of the mouth after certain plastic operations upon the lips, and which, without great care on the part of the surgeon, is certain to defeat his operation. Indeed I have generally found it impossible to prevent the union of the parts thus divided, except by covering one of the raw surfaces with the mucous membrane dissected from the inside of the lip.

While, therefore, the accoucheur may be advised to maintain actual contact of the raw surfaces by position, in the remote hope that some adhesion may occur, there is not in this possible chance of small results a justification for operative surgical interference. The parts should certainly not be needlessly or forcibly drawn asunder, but they may be carefully exposed to view each day, and made clean by gentle ablution; and the urine should be drawn by a flexible catheter as often as may be required for the relief of the patient, to whom nothing is more distressing than the contact of the urine with the raw surfaces of the wound.

In further support of the opinion above given, that an immediate operation is not in most cases, if ever, advisable, it must be explained more fully that, if it were possible to secure union by adhesion at this early period, the operation must be made within a few hours at most. Hewitt, who advises the early operation "when the rent is at all considerable," says "the primary operation should be performed within one hour from birth, while the surfaces are still raw and bleeding." . . . "It is of very little use in inserting sutures when the labor has been over some hours; union rarely then occurs." This statement is doubtless correct, and my experience in a great variety of plastic operations compels me to doubt whether the operation will be any more successful if made within an hour. The reasons for this opinion have already been assigned. But we may properly ask Mr. Hewitt what is to be done with that very considerable number of cases in which the expulsion of the placenta is delayed beyond an hour? Shall the rent be closed before it is expelled, at the risk of the sutures being torn out by its subsequent passage? Or is the accoucheur again to interfere with the course of nature, and, with more or less violence, as may become necessary, remove the placenta without reference to the present general condition of the patient or of the uterine contractions?

From any point of view it comes to this, that it is proposed to make an operation, by no means trivial in its character, not to speak of the subsequent special management of the bowels required, and the removal of the sutures; which operation at the best is very liable to fail, and which may subsequently, in case no operation is made, be found to have been unnecessary; or which, if it becomes necessary, can be made more thoroughly and successfully at a later period—it is proposed, I say, to make the operation under every surgical disadvantage, and when the patient, prostrated and trembling from the results of a severe labor, is in the worst possible condition, both mentally and physically, to endure the shock of an operation, or even its announcement. Nothing but the most urgent, imperative necessity can justify the operation under these circumstances, and this necessity has not been shown to exist.

At this early period, also, it is often difficult to form anything like a definite opinion as to the actual extent of the lesion. A rent, which at first seems to be an inch or two in length on account of the distended condition of the perineum, will, after contraction, a few hours later, be found to be not more than a quarter or half an inch.

Secondary Operation.—In case the rent involves the perinæum only, the integrity of the sphincter ani being preserved, the preparatory treatment will consist in a thorough evacuation of the bowels with a saline cathartic, administered forty-eight hours before the operation is made. On the morning of the operation the rectum should be emptied by a copious enema of warm water, to be followed by a suppository containing half a grain of morphine. The patient being then anæsthetized and placed in the usual position for lithotomy, while an assistant displaces the upper wall of the vagina with a Sims' or Bozeman's speculum, the surgeon will proceed with mouse-tooth forceps and scissors to denude the surfaces which are to be brought into contact. These surfaces should be extensive, rarely less than one inch in the antero-posterior direction, and they should extend inward along the vaginal wall nearly as far. The denudation must also be complete, the interposition of the smallest portion of the mucous or tegumentary membrane between the lips of the wound being sufficient to partially or wholly defeat the operation. All bleeding having ceased, three well waxed sutures, of the largest size of harness-makers' silk, are to be introduced, the first being placed at the angle of the wound close to the sphincter. The needle, armed with a double ligature, must be inserted at a distance of from three-fourths to one inch from the margin of the wound, carried to a sufficient depth to include the entire surface which has been made raw, and brought out at a corresponding point upon the opposite side. Each suture will be introduced in the same manner. Sections of a rather large-sized flexible bougie, one inch longer than the fissure, are to be laid upon either side, over which the double sutures must be tightened until the lips of the wound are brought together with moderate firmness, and the sutures tied. In most cases, in order to secure accurate apposition of the margins of the wound, it is well to insert two or three very delicate superficial sutures. The knees of the patient should then be tied together lightly, with a small pillow interposed between the knees, and she may be left to repose upon her back or side, as may best suit her comfort.

The after-treatment demands the most careful attention. The bowels should be kept quiet for several days. The parts should be subjected to daily inspection and kept clean and dry. The urine should be drawn as often as may be necessary. The deep sutures may be permitted to remain six or seven days, or even longer, if they cause little or no irritation, but the fine sutures may be removed earlier. Finally, rarely sooner than after ten days, the bowels should be moved, and the rectum emptied by the aid of physic, enemata, and by mechanical assistance if necessary.

In case the rent involves more or less of the recto-vaginal wall, the difficulties of the operation will be greatly increased, and it will be advisable always to paralyze the sphincter by two lateral incisions, extending backward and outward on each side, as first recommended by Baker Brown. The deep sutures must be kept in place as long as they serve a useful purpose, the evacuation of the bowels must be longer delayed, and after the sutures are removed the parts must be kept at rest and in contact until a firm union is insured.

I have made no reference to the use of the wire sutures in this operation, because, so far as the management of the perinæal rent is concerned, I prefer to employ the so-called "quilled" suture, only substituting the bougie for the quill, and for the reason that I do not find the wire so easy to introduce or to remove; nor have I found it, where the perinæum alone is torn, to possess advantages in any other respect. If, however, the rent or loss of structure involves any considerable portion of the recto-vaginal septum, I would recommend, so far at least as the rectal fissure is concerned, the wire suture either with or without Bozeman's clamp; but I must acknowledge that, in the treatment of this very difficult class of cases, I have had no practical experience, and cannot therefore speak authoritatively. I would prefer always to refer such cases to those who have had special practical experience in this department of surgery.

CHAPTER XIX.

ANÆSTHETICS.

SECTION I.—GENERAL ANÆSTHESIA.

Ether and Chloroform.—In the second edition of my Treatise on Military Surgery and Hygiene, published in 1865, I have considered the utility and application of general anæsthesia at considerable length. Since that time the subject has been a good deal discussed, but nothing has been said, so far as I am informed, or has occurred in my personal experience to change or modify my opinions and conclusions as then expressed. I shall, therefore, take the liberty of reproducing a portion of my argument, with the summary of my conclusions as given in the treatise referred to.

It is very natural, while contemplating the virtues of one of the most valuable discoveries ever made in medicine, that we should overlook and be reluctant to admit its defects. The danger is indeed very great that we shall do so.

Most surgeons have had occasion to notice the appearance presented by the stump immediately after an amputation made upon a patient completely narcotized by chloroform. The muscles hang out very much as they do in operations made upon the cadaver; they never quiver nor retract; nor, in some cases, is the retraction of the muscles completely accomplished until after several hours or even days. They bleed freely under these circumstances, but it is seldom we shall find lymph, the presence of which is so essential to primary union, deposited upon the surface of the wound, even when it has been allowed to remain open an hour or more. To me it seems quite impossible that these conditions of wounds should be favorable to their early union, and my personal experience justifies me in saying that they are not. My conclusions in reference to the effect of these agents may be summarized as follows:

Anæsthetics are of inestimable value in their power to extinguish sensibility temporarily, especially during the performance of certain painful surgical operations; in the control which they exercise over muscular action, thus facilitating the reduction of dislocations; and in very many other ways.

Anæsthetics, however, produce certain effects upon the system which tend to prevent union by first intention, especially noticeable in large operations, or in cases accompanied with extensive structural lesions; and consequently they must be regarded as, indirectly, causes of suppuration, pyæmia, secondary hæmorrhage, erysipelas, and hospital gangrene.

Ether ought generally to be preferred to chloroform, as being less liable to destroy life immediately; but no anæsthethic ought to be employed when the system is greatly prostrated by disease, or by the shock of a recent injury, or by loss of blood, unless the patient exhibits an unconquerable dread of the operation, or the operation is likely to prove exceedingly painful.

It ought to be particularly borne in mind that by the loss of a large amount of blood, the action of absorption is greatly increased, and that, consequently, such patients come more rapidly under the influence of the anæsthetic.

During the exhibition of an anæsthetic the room should be kept quiet. There should be no conversation permitted; the effect of which is usually to arouse or excite the patient, and to delay the anæsthesia.

Infants are more promptly and probably more safely affected by anæsthetics than adults; and persons of a phlegmatic temperament come more easily under their influence than persons of a sanguine or nervous temperament.

No patient ought ever to take ether or chloroform in the sitting posture. A large proportion of the fatal cases have occurred in the hands of the dentists, when the patients were sitting, or only partially reclining. The safest position is reclining upon one side; when the patient lies upon his back he is in some danger of suffocation from the falling of the tongue and epiglottis, and the accumulation of fluids in the mouth.

When ether is administered, a towel, enclosing a portion of a newspaper, to give it firmness, and to prevent evaporation, should be folded into the form of a cone, the base of which should be large enough to inclose the whole face; a large sponge should be thrust to the bottom of the cone and saturated with ether.

The base of the cone being laid over the face, the patient should be instructed to make a full inspiration, and as soon as this is done the cone should be removed, so that he shall not be required to inspire again the air which he has just expired; when the patient repeats the inspiration the cone should be replaced upon his face, and again withdrawn on expiration.

By this method the subject may be brought rapidly under the influence of the ether, and he is in no danger of being suffocated. It is painful to see how some surgeons hold down and strangle their patients in their rude attempts to administer anæsthetics. The battle for air which the poor sufferers make increases their exhaustion, while the spasmodic closure of the glottis prevents the anæsthetic from being received into the lungs, if it does not actually endanger suffocation. No surgeon, it is believed, would ever permit the same to be done to himself, whatever might have been his own previous views of the value of this practice.

While the anæsthetic is being given, the pulse should be held by the surgeon, and the respiration, countenance, and the reflex action of the lids on touching the cornea, carefully noted. The patient should be occasionally spoken to, and when he ceases to respond, or the lids cease to respond to the touch upon the cornea, the operation should commence at once; and the anæsthetic should, in most cases, be discontinued before the operation is completed. In short, the inhalation of the anæsthetic ought not in any case to be prolonged one moment unnecessarily.

If respiration or pulsation ceases, the tongue should be drawn out by the aid of a hook, if necessary; and the head of the patient dropped over the side of the table or bed; or he may be rolled over from his side to his face, or from his face to his side, and these motions should be repeated several times, pressing meanwhile upon the chest to imitate respiration. The chest may be forcibly struck with the palm of the hand. But of all measures, the application of the galvanic current to the regions of the diaphragm and heart, is the most valuable, and should be resorted to whenever it is practicable.

I have seen no benefit from stimulants or opiates given internally, either before or after administering anæsthetics. They seem only to increase the tendency to nausea and vomiting. If possible, the stomach ought to be entirely empty when anæsthetics are given, and it should remain so for some time after.

The patient being removed to his bed, should be allowed to sleep, with an abundance of fresh air circulating about his face. When he awakes, and consciousness is fully restored, he may be allowed a small cup of hot coffee or of tea, provided, of course, there is no nausea. If he is inclined to retch, small pieces of ice will be preferable.

There is usually considerable nervous excitement, manifested especially in a disposition to talk, during the twenty-four or forty-eight hours following the inhalation of the ether. Strangers should not be admitted to the bedside, and the friends must enjoin quiet and silence. The patient seldom sleeps much after he is once fairly wakened, for many hours; but all drugs exhibited for the purpose of inducing sleep during this period tend to induce nausea and to increase the prostration, and had better be withheld.

Nitrous Oxide demands for its successful exhibition the complete exclusion of atmospheric air, causing then a species of asphyxia. Given without the admission of atmospheric air, its effects are prompt and complete, but of very short duration. It is, therefore, of very little use except to the dentist, by whom it has been much employed in the extraction of teeth.

The number of deaths which have resulted directly from its use, considering the frequency of its exhibition, has been small, yet every now and then a fatal case has been reported. A few years since, a strong, healthy woman died in the dentist's chair in this city while under the influence of nitrous oxide. The danger to life would no doubt in these cases be diminished if the patient were in the recumbent position, but that position would be inconvenient for the dentist, and would expose the patient to another serious danger, namely, the swallowing or inhalation of the teeth or their fragments, a danger which is not completely removed when the patient is in the sitting posture. I am not aware that dentists have called attention to these accidents, but recently a fatal case of inhalation of the fragment of a tooth, while the patient was under the influence of the nitrous oxide, has been reported in the daily papers. The accident occurred in New Jersey, the patient dying from the pulmonary disturbance caused by the fragment after the lapse of several months. Still more recently a similar case came under my own observation, the operator being a gentleman in this city, who made the extraction of teeth under nitrous oxide a specialty. This case also terminated fatally after a few months.

Recent experiments and observations seem to have shown that the admixture of oxygen gas with the nitrous oxide in certain proportions averts the danger of asphyxia, while it does not diminish the anæsthesia. It is to be hoped that future experience will confirm this observation.

Bichloride of Methylene, and the **Bromide of Ethyl,** both of which possess anæsthetic properties, have been found to be capricious and unsafe, and cannot properly be recommended as substitutes for either one of the anæsthetics already named.

SECTION 2.—LOCAL ANÆSTHESIA.

Cold.—All cold or freezing mixtures, and also those agents which by their rapid evaporation produce cold, have been occssionally employed as means of producing local anæsthesia.

Pounded ice or ice-water, inclosed in a bladder, may be temporarily applied, with the effect of diminishing or of completely destroying the sensibility of the tegumentary or superficial structure.

Ether thrown upon the parts by means of an atomizer, as first suggested by Dr. Richardson, of London; or **Rhigoline** employed in the same manner by Dr. Bigelow, of Boston, will cause an intense degree of cold, and even freeze the parts in a few minutes.

The objections to all of these methods are that they act only superficially; that in the first period of their application they are sometimes painful, even more so than the operation would have been, and that they may sometimes, like an ordinary frost-bite, induce a low grade of inflammatory reaction unfavorable to healthy and prompt union. Their application is therefore limited to a few minor operations, such as opening abscesses, the excision of small tumors, etc., in most of which cases, however, patients are willing and able to submit to the application of the knife without anæsthesia.

Cocaine Hydrochlorate.—An alkaloid obtained from the leaves of erythroxylon coca, a plant indigenous to the elevated mountain ranges of Bolivia, Peru, and Chili.

The infusion of coca leaves, taken internally in moderate quantities, causes temporarily increased muscular endurance, and very closely in this respect resembles coffee, tea, and tobacco.

The alkaloid cocaine, taken internally in doses of from one-sixth of a grain to two grains, produces a similar effect; but when the doses are increased or continued it causes vertigo, dilates the pupil, diminishes the force of the heart, lessens the secretions, and gives rise to a general feeling of weakness and malaise.

It exhibits, however, little or no lethic or narcotic effects; from which we are to infer that it can never be employed as a general anæsthetic. Precisely what may be considered a toxic dose has not been well determined. Ploss reports the case of a druggist who took about 22 grains without causing death, but he suffered greatly from vertigo, griping, vomiting, etc. His intellect remained unaffected.

As a local anæsthetic, cocaine has displayed remarkable powers. It is now but little more than a year since its local anæsthetic properties were first fully made known by Dr. C. Koller, of Vienna, and it has already achieved for itself a remarkable reputation, while the real extent of its usefulness can, at this moment, only be partially known.

A solution of from two to four per cent has generally been employed as a local application, but in some cases it has been employed of the strength of ten to twenty per cent with no injurious results. Its physiological effects seem to depend upon its rapid absorption by which it is brought into direct contact with the nerves and blood-vessels; as might be inferred, therefore, it acts most promptly and decidedly when applied to abraded or raw surfaces, or to mucous surfaces. It seems probable that it would act in the same manner if applied to serous surfaces, but I am not aware that any practical observations of this kind have been made. Its action upon unbroken tegumentary surfaces is almost or absolutely nothing.

The limits of its action do not extend, in the direction of the surface, much beyond the parts to which it is directly applied; but in the direction of the underlying tissues it extends farther, yet not uniformly to the same depth. By repeated applications, however, it may be made to penetrate more deeply.

Cocaine has demonstrated for itself other properties than its ability to relieve pain and to destroy local sensibility. It dilates the pupil. In the rectum, it has been said to cause muscular contraction of the sphincter and levator ani, while in the throat it has been said to cause paralysis of the muscles of deglutition—a statement the accuracy of which seems to be questionable, the peculiar sensations and the dyspagia caused by its application to the pharyngeal muscles being, as suggested by Dr. Bosworth, of this city, due probably to the dryness of the fauces caused by the arrest of the secretion, and by the total loss of sensibility.

It contracts blood-vessels, and may be employed to arrest parenchymatous hæmorrhage; operations made under its influence usually bleed less; but one of its most interesting and practical effects, recently noted by Dr. Bosworth, is the contraction of the erectile tissue covering the turbinated bones. Dr. Bosworth states his experience as follows: When a pledget of cotton saturated with a two-per-cent solution is applied, there follows, "in about twenty or thirty seconds, a notable contraction in the venous sinuses underlying the part which it reaches; and as the application is continued over the whole membrane covering the lower and middle turbinated bones, these sinuses become so rigidly contracted that all the blood which they may have contained is absolutely expelled, and the membrane clings closely to the bony structures which then become visible in absolute outline."

It would be impossible to indicate all the surgical and therapeutical purposes to which cocaine has been successfully applied, nor would it be useful to do so. The intelligent surgeon, understanding its physiological action, will have no difficulty in selecting for its employment the appropriate cases.

CHAPTER XX.

SUPPLEMENTARY.

THE ART OF PRIMARY UNION, OR UNION BY ADHESION IN LARGE INCISED WOUNDS; WITH A CONSIDERATION OF THE VALUE OF ANTISEPTICS IN THESE AND OTHER WOUNDS.

In the following pages I shall employ the terms "primary union," "union by adhesion," "union by coagulable lymph or by fibrin," and "union by adhesive inflammation" as synonymous, recognizing no other forms of primary union than those which have been thus variously designated by different writers, and of which the last mentioned is, perhaps, the most representative.

The conditions requisite to insure "primary union," or "union by adhesive inflammation," in large incised wounds, are:

First, a good, or at least an average state of the general health, and especially the absence of any systemic infection or dyscrasy, such as pyæmic or septicæmic infection, struma, syphilis, etc.

Second, the removal of all foreign bodies from the wound.

Blood lying between the cut surfaces is a foreign body. It must therefore have ceased to flow, and such as remains upon the surfaces must be carefully removed. It must be rendered certain, also, that it will not again flow after the wound is closed.

Soon after the infliction of the wound, when the bleeding has wholly ceased, serum, a product of the first stage of reaction, begins to be poured out, and in greater or less amount, according to the extent of the surface exposed, and the degree of the reaction. Equally with blood it is a foreign substance. If effused in small quantities, however, it may be absorbed; but if effused in large quantities it will not be absorbed, and will as effectually prevent primary union as the presence of blood; and since it often continues to flow for three or four days after the wound is closed, it will be necessary, in many cases, to provide for its escape by suitable drainage.

Third, lymph, or as it is also called, coagulable lymph, soon begins to be effused, coincident with the second stage of reaction. If the reaction does not exceed certain bounds it is euplastic, and is the material by which, or through which, primary union is to be established. It coagulates readily, and its presence upon an open wound is usually indicated by the glazed appearance of the surface. It is advantageous, therefore, to leave the wound open until this appearance is presented.

Fourth, in the cleansing, closure, and dressing of the wound every precaution must be taken not to do any unnecessary violence to the parts, either by the hands, the sponges, sutures, adhesive strips or bandages, or at a later day in the renewal of the dressings, since all these things tend to increase the inflammatory reaction, and to carry it beyond the limitations which are assigned to the effusion of euplastic lymph. In short, they precipitate suppuration.

The same conditions are requisite for securing primary union in *contused* and *lacerated* wounds as in simple incised; but in consequence of the immediate devitalization of the tissues, resulting in the formation of sloughs, or of the excessive inflammatory reaction occasioned by the violence done to the parts, the portions of these wounds which will be permitted to unite by adhesion will be comparatively small; and in some cases the promise in this direction is not sufficient to warrant the attempt.

The several conditions above named as necessary for the union of large wounds by adhesion are not now for the first time declared. Their first enunciation was made substantially in the latter part of the last century, and were repeated often by systematic writers. They were a part of my earliest lessons in surgery, and have been taught and practised by me during all my professional life up to the present time.[1] I believe, also, that a strict compliance with these rules constitutes the only grounds for the superior success of some surgeons, as compared with the success of others, at the present day; and if their success is greater than that of surgeons who fifty or one hundred years ago practically applied these rules—and I am willing to concede that it may be, although it is not proven—it is because they have more exactly complied with the conditions named.

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[1] "Having tied all the main trunks, I advise you to wait until oozing ceases" . . . "time is of no consequence" . . . "you are not to make haste solely for effect" . . . "when we used to talk more about union by first intention, we advised to

In order to place before you satisfactorily my grounds for this belief, it will be necessary to recall, briefly, the history of this department of surgery.

As to the best mode of treating large incised wounds, the opinions of surgeons have differed in different periods of the history of surgery. These periods have usually been arranged under two divisions, namely, the earlier period, in which it was taught almost universally that they must be left open, in order that they might unite *by granulation*: and the later period, dating from the latter part of the last century, in which it has been taught that they should be closed, and encouraged to unite *by adhesion*.

It will appear, however, that during the latter part of the second period, for one reason or another, the practice, if not the teachings, of surgeons has at times greatly faltered, if it had not at one time, not very remote, gone back fully to the practice of the first period. Surgeons again preferred to leave their large wounds open, to suppurate and close by granulation. Certainly very many practised it, and not a few publicly taught that this was the best method. Among the most notable examples of conversion, and of a complete return to the practice of the earlier period, or to the "open air treatment," as it was usually called by the revivalists, was my colleague, the late distinguished Prof. James R. Wood, of Bellevue Hospital and College, who both practised it and publicly taught it during many of the later years of his life.[1] This lapse of faith has happily been overcome, and confidence in union by adhesion is to-day completely restored. The probable causes of these fluctuations of opinion will, perhaps incidentally, be made apparent in the following history, although my main purpose is to show that the principles underlying success are the same now as they always were.

The first serious attempts to secure union by adhesion after large am-

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keep the wound open until it became *glazed*. In my opinion this is good practice to-day. All hæmorrhage may not cease under an hour, or two hours; but that constitutes no sound objection. Leave it open, we say, until the surface is a *little glazed*; now fibrin or lymph has been poured out, and the two surfaces, when applied, became at once glued together, as if wax had been placed between them, and the chances of union by first intention are greatly increased."—"Clinic on Amputations at Bellevue Hospital," by the Author; published in *The Medical Record*, Nov. 1, 1866.

[1] "On the Treatment of Amputation by the Open Method," by Frederick R. Dennis, M.D., *N. Y. Med. Journ.*, 1876, vol. 23, pp. 8–26.

putations were made by Edward Alanson, of Liverpool, whose book, entitled "Practical Observations on Amputations," was published in 1779. His practice and opinions soon found acceptance with the large majority of surgeons in all parts of the world. They were adopted by Hey, Percy, Lucas, Guthrie, Syme, Liston, and Bennett, in England; by Pirrie, in Scotland; by Velpeau, Dubois, Boyer, Dupuytren, Delpech, Richeraud, and Roux, in France, and by most of the German and American surgeons.

In what manner this union was to be accomplished, they have constantly, with more or less minuteness of detail, informed us.

Alanson speaks of the importance of securing every bleeding vessel, of drawing the arteries out with a tenaculum, so that the ligatures shall not include other tissues, and thus form sloughs or delay their removal; of making the flaps so long that they will come together without strain, and of securing proper drainage.

Says Velpeau, speaking of incised wounds in general: "In order to attain this end, we must give to the dressing more care and time than is ordinarily given to it; the section of the soft parts should be neat and regular; the integuments should fall without effort on the front part of the stump." . . . "All the arteries liable to bleed should be immediately tied or twisted; the sides of the wound, free from foreign substances, should touch throughout their whole surface." . . . "The straps should do no more than preserve the coaptation, without pressing or exercising any drawing force." . . . "The suture should be added to them, or even preferred, if the skin is thin or tends to roll inward; the diseased parts should be afterwards kept in the most perfect immobility, and the inflammation should be moderated by every possible means."

When speaking of amputations, Velpeau repeats in effect the same instructions.

Most of these surgeons have referred in their writings to the necessity of waiting until the surface of the wounds become *glazed*, before closing them.

"After a time," says Bennett, "the surface is glazed, as it is called;" and it is at this period that he recommends the closure of the wound.

Says Pirrie: "All oozing having been completely arrested, foreign matter removed, and the surface having taken on a glazed appearance," we may proceed to close the wound.

Not a few of the most distinguished operators went much farther both in their teaching and practice.

Mr. Syme says wait six or eight hours before closing the wound.

Velpeau says that "in order to arrive with more certainty at this result, Parrish, in America, and also a great number of surgeons in England and Germany, and Dupuytren, in France, have established a precept not to dress recent wounds but after the lapse of some hours." Dr. Townsend, in a note to the American edition of Velpeau, says that Dr.

Valentine Mott "approves very highly of leaving many wounds exposed for some time, even for an hour or more."

Of those mentioned above, Mr. Syme subsequently modified his opinion so much as to permit the dressing to be made at the same time as the amputation.

Even at a date much later than any writer which has been hitherto mentioned, Mr. Erichsen has said, "Hence in the dressing of surgical wounds, such as stumps after amputation, and in all cases in which it is advisable to attempt to procure union by adhesive inflammation, the cut surfaces should not be brought together for a few hours, until all oozing of blood has ceased and the fibrinous layer has been thrown out."

It needs to be said that, following the example of Mr. Syme, after a time most surgeons relinquished the practice of waiting several hours before closing the wound, both because of its inconvenience and because in most cases the glazed appearance was found to be present sufficiently early to enable them to do so without compromising the desired result.

Alanson, Syme, Liston, and probably all the systematic writers of this period, taught the necessity of not only stopping all bleeding, but also of providing for the escape of serum by suitable drainage. Mr. Syme, in 1825, wrote a paper in which he spoke of the flow of serum as "invariable," and of the absolute necessity, therefore, of providing for its escape.

Let us now inquire what were the results of this plan of treatment, which was substituted for the open treatment, and which found favor with so many—nearly all, indeed—of the most practical surgeons at the close of the last century and up to a late period during the present century.

Alanson declares that, under his improved treatment, of 35 cases of amputation of the leg and thigh, at the public hospital in Liverpool, he did not lose one, while of the preceding 46 amptutations he had lost 10.

Mr. Liston, a pupil of Syme's, says, that of the last 20 cases of amputation of the thigh for chronic disease, which he had seen performed by Mr. Syme under this plan of treatment, not one died; and this although some of them seemed in a nearly hopeless condition at the time of the operation.

Of 92 soldiers treated in this manner on the field of battle by Percy, 86 were cured in twenty-six days; and of 70 cases thus treated by Lucas only 5 died.

It is true that Pelletan, who did not favor the practice of attempting union by adhesion, lost 5 out of 6 treated by himself; but it is sufficiently apparent that he had not complied with two of the most important conditions of success, when he declares that in all the fatal cases the autopsy showed the presence of blood, as well as of pus, between the surfaces of the wounds; and that in the only case in which recovery took place the accumulated pus forced off the adhesive straps. He had neither secured the bleeding vessels properly, nor provided for drainage.

What treatment, either ancient or modern, has presented a better record than this furnished by Alanson, Syme, Liston, Percy, Lucas, and, so far as we know, by the faithful disciples and distinguished advocates of their practice?

It is scarcely necessary to remind the reader that these results were obtained before the introduction of anæsthetics or of antiseptics.

In the face of these remarkable and universally conceded successes, which contrasted so strongly with the slow and uncertain results of the earlier practice, it is hard to understand how any steps backward could have been taken; but this is what actually happened, the retrograde movement commencing even before the distinguished advocates of the new system had died. Here we enter that point in the history of the treatment of wounds to which I have already referred, as that in which the practice of attempting to obtain union by adhesion "faltered," and surgeons were everywhere returning to the practice of leaving their large incised wounds to suppurate and granulate.

Of the fact, as now stated, there is no question. How this change was brought about I will now attempt to explain, and also how, through the agency of one man, Mr. Lister, the practice of union by adhesion was happily restored.

In the first place, to comply with all the conditions demanded for union by adhesion requires time and painstaking. It demands scrupulous attention to the most minute details. To omit one of the many conditions named is, in most cases, as fatal as to omit the whole. Celerity is here inconsistent with success. Surgeons, therefore, who wish to acquire a reputation as "brilliant" operators are likely, especially in their public or hospital exhibitions, where their example can do most harm, to fall short of the requisition, and then, by their failures, to bring discredit upon the system they teach and are attempting to follow.

Second, war is unfavorable to this department of surgery. The exigencies of the battle-field do not supply the time, nor the appliances necessary for the application of all the principles involved in primary union. There are many occasions on the field of battle when the demands upon the surgeon to save the life of the patients temporarily must be paramount to all other considerations, and in which, as Armand has said, the only precept is, *cite, citissime.*

Macleod says, speaking of his experience in the Crimean war: "I never saw one case among our most numerous amputations in which primary adhesions took place throughout the whole surface of the flaps."

My personal experience in our late civil war was that primary union, after large amputations, was the exception; and that, toward the close of the war, army surgeons were everywhere returning to the practice of open dressings. This lack of success in their attempts to secure primary union upon the field induced, it is fair to suppose, in the minds of many who did not sufficiently consider the causes of their failures, a general lack of confidence in the plan, which led them to reject it even after they returned to civil practice.

If Percy had better success as an army surgeon in securing primary union than most other surgeons have had, it was because he was better able to comply with the conditions.

Third, the introduction of anæsthetics has had no inconsiderable influence. My own experience has not furnished me with any evidence that general anæsthesia has appreciably delayed the union of tegumentary wounds, or of the majority of small wounds, when they occur in most of the other tissues of the body. What the fact may be in this regard, I am unable to say, nor would it perhaps be very easy to determine; but in reference to its effects in large muscular wounds, or in major amputations, and especially where muscular flaps are made, I have no doubt their union has been thereby delayed and often prevented.

I practised surgery some years before the introduction of anæsthetics; and soon after I began to use them it became a matter of common observation with me, and of comment, that the same measures did not so often insure primary union as before. I think also that Macleod's experience in the Crimean war, already referred to, goes further than proving that amputations made under these circumstances do not usually comply with the conditions of success. He says that "chloroform was almost universally used in the British army." If, then, he was unable to meet with a single case of complete primary union, it seems fair to charge a part of this result to the general use of chloroform.

But, aside of any specific testimony upon this subject, let me appeal to the reader's intelligent judgment. When large flap amputations are made while the patient is completely under the influence of an anæsthetic, in addition to the total loss of sensibility—for which both operator and patient have reason to be thankful—we observe, as I have already said in the chapter on anæsthetics, that the muscles do not quiver and retract under the knife, that they hang apparently lifeless from the wound as they do when made upon the cadaver, and that they do not wholly resume their normal contractility and position until some hours after the operation is completed. The arterial blood is dark, and can scarcely be distinguished from the venous, showing that it is imperfectly oxidized. The surface of the wound has a dark, grumous look, wholly unlike the appearance presented under other circumstances.

Is it reasonable to suppose that the effusion of lymph, so as to give a glazed appearance to the wound, and which is essential to primary union, will not, under these circumstances, be delayed? and that this delay will not often extend beyond the period when primary union is possible? For myself, if I were asked this question, and no evidence were presented on either side, I would say it must necessarily be delayed.

I have been speaking thus far of the circumstances which seem to explain why surgeons for a while faltered in their faith in primary union. This explanation, however, which may or may not be correct, was not necessary to the historical sketch which I proposed to make. The material point is, that for a time surgeons did actually treat wounds as if they had forgotten the conditions of success, or had lost faith in the earlier teachings.

In attestation we have only need to recall what we have often witnissed in the public amphitheatres in this city and elsewhere during the last twenty or thirty years; large flap amputations, made dexterously, but afterward the surfaces of the wound rudely handled, fretted by rough sponges, the wounds closed before the blood had ceased to flow, then hermetically sealed by adhesive straps, without provision for drainage, and hurried from the amphitheatre to make way for another brilliant operation.

To one who has only observed the results of this method of treatment, without having given attention to the means by which they were brought about, the sole conclusion must be, that it would be far better to return to the old practice of leaving the wounds open, since nothing short of a miracle could secure primary union; and this is precisely the conclusion to which, within a few years, some surgeons have arrived.

We have now reached the period in the history of surgery when Mr. Lister interposed, and turned back the tide. He taught that under a most thorough system of antisepsis primary union could be secured; and he demonstrated that it could be secured even after the most profound anæsthesia. This was the great lesson which he had in his mind, and which he successfully taught; but he taught also, incidentally, that the wound must be handled gently, all foreign substances must be removed, the blood must cease to flow, and provision must be made for drainage. In short, if you will look carefully into his teachings and practice, and the practice of his disciples, you will see that they omit nothing which, in the opening of this paper, I declared essential to success; and I venture to say, that if they did, no amount or quality of antisepsis would secure union by adhesion. The influence of Mr. Lister, backed by his specious theories, secured a return to the old practice of the advocates of primary union in all its essential details, and to this it added antisepsis.

Fortunately, antisepsis carried with itself, inseparably, one thing more, namely, the agency of a moderate stimulant and astringent, which served materially to resuscitate the tissues and the capillary vessels which had been temporarily paralyzed by the general anæsthesia, and thus in some measure to counteract its deleterious effects.

As to his practice of removing carefully and effectually all foreign substances before closing the wound, and providing for the escape of the serum or blood which might subsequently be effused between the cut surfaces; and as to his practice of applying industriously, so long as the wound was open, a moderate stimulus to the cut surfaces in the form of spray or lavements of dilute carbolic acid—these are *facts* which admit of no dispute. But as to his declaration that the results which he obtained were due to the destruction of certain micro-organisms constantly floating in the atmosphere, and which being received and propagated upon the raw surfaces prevent primary union, or which being conveyed into the system by absorption cause septicæmia—this is only a *theory*, and one which is far from being universally accepted. It has not been conclusively shown that the formation of pus depends in any case upon the presence of germs. When suppuration takes place in closed cavities these germs are generally absent; but as if to show how impossible it is to prevent their pernicious intrusion—in case it be admitted that they can or do cause suppuration—they are occasionally found in great numbers in cavities which have never been open to the air.

If germs are so readily absorbed by open surfaces, and distributed through the system, of what possible use is it to commence the application of the antiseptics one or several hours after the reception of a wound, or months after the skin has been destroyed, and then apply it with so much assiduity, so long as the knife of the surgeon or his hands are in the wound?

If, on the other hand, the germs are not so easily absorbed, and only nestle upon the surface of the wound, why, instead of using the antiseptic from the beginning to the close of a surgical operation, is it not sufficient to apply it thoroughly just before closing the wound?

There is one quality or property of antiseptics to which allusion has not yet been made, namely, their power to prevent the decomposition of blood, of pus, and of serum; the decomposition of either of which changes these otherwise comparatively innocuous fluids into an irritating ichor. But when employed for this purpose they can serve no useful end, except when blood, serum, or pus are actually present. To apply them, therefore, immediately preceding the closure of the wound, and whenever subsequently blood, serum, or pus present themselves or seem likely to present themselves is rational, and would justify their employment also, within certain limitations, in all cases, after the closure of the wound and until the end of the treatment; but it supplies no argument for the adoption of all the complicated procedures with which Mr. Lister and his disciples preface and encumber their operations.

The conclusion to which we are brought is, that while we are indebted to Mr. Lister for having restored confidence in union by adhesion, it seems equally certain that his excellent results have been obtained, not by a literal compliance with the rules which are the logical deduction from his theories, but by his strict enforcement, in the practical application of his theories, of certain other conditions, which he seems to regard as accessory and incidental, rather than of paramount importance.

If this conclusion be correct, then there is not sufficient reason why the air of a room in a private house, or even in a public hospital, not suspected of being infected by some contagious or infectious disease, such as diphtheria, scarlatina, erysipelas, etc., should be disinfected before an operation is performed, or why all persons present should have been previously disinfected, or that they should be required to breathe through disinfecting respirators, or should wash their hands in carbolized water, or search beneath their nails for concealed germs, or carefully wash all the neighboring integument—the whole limb, for example, in the case of an amputation—first with soap and water, and then with a disinfectant, before commencing the operation; or why they should carbolize their instruments; or why, indeed, they should pour a constant stream of carbolized water or of spray upon the wound while operating, except, as I have already stated, for its utility in removing the coagulated blood entangled in the cellular tissues, in closing the capillary vessels, and its power in restoring tone to the paralyzed tissues when anæsthetics have been employed. There is no sufficient reason why they should finally cover the wound with "protectives," "lac plaster," numerous layers of carbolized gauze, and carbolized cotton batting, and why most of these processes should be repeated at every subsequent dressing.

The various manipulations and devices for the purpose of excluding the germs above enumerated, with others not enumerated, have at one time or another been suggested by Mr. Lister or his disciples, and, in my opinion, they are all necessary if Mr. Lister's theory be correct. If it be not correct, they serve no other purpose than do the walking, talking, and gestures of the prestidigitator. They abstract the attention, and conceal the adroit manipulation by which the trick is actually performed.

I say this with all respect for the integrity of the distinguished surgeons who hold strictly to Mr. Lister's opinion and practices, since in one particular they differ from the class to which I have compared them. The prestidigitators are not deceived, but deceive their audiences; while Mr. Lister and his disciples deceive both themselves and their audiences.

It will be observed that I have thus far spoken only of carbolic acid as an antiseptic, since it is that which was first used by Mr. Lister, and still continues to be more commonly used than any other; but I am aware that surgeons have lately substituted many other things for carbolic acid, and with equally satisfactory results; and that many who continue to prefer carbolic acid have rejected the continuous spraying, and in several other particulars have modified the treatment. At the present moment a weak solution of the bichloride of mercury is the most active contestant of the alleged superior virtues of carbolic acid.

In a paper read before the New York County Medical Association in February, 1885, Dr. Theodore R. Varick, surgeon to St. Francis' Hospital, Jersey City, N. J., states that he has for nearly six years substituted hot water, or water a little below the boiling-point. Immediately after the larger vessels have been tied, he applies the water freely and continuously to the raw surfaces until all oozing has ceased and "the parts are thoroughly glazed." The effect of this is, as claimed by Dr. Varick to coagulate the albumin in the serum, by means of which the open vessels are closed against the admission of germs, and to impart a moderate stimulation.

In a private letter Dr. Varick informs me that of thirty-nine major amputations thus treated, mostly in cases of railroad accidents, only two terminated fatally, one by hemorrhage and one by cardiac disease; and that in all of the various operations performed by him there has been no case of septicæmia or of pyæmia, "although in several instances the hygienic surroundings have been of the worst kind."

Dr. John D. McGill, surgeon to the same hospital, says, that having seen the "wonderful effects" of Dr. Varick's hot-water treatment he was led to adopt it; and that, while of five previous amputations made by himself "*à la Lister*," two had died unmistakably of blood-poisoning, of twenty-nine amputations made since he adopted the "Varick method," only six have died, and not one from blood-poisoning.[1]

Dr. Varick attributes his remarkable success, which is probably equal to that obtained by those who adhere to the use of carbolic acid, or of the bichloride of mercury, to the power of hot water to close hermetically the capillaries, and thus to prevent the admission of germs. While I fully approve of Dr. Varick's practice, I do not accept the theory offered by him in explanation of his success, at least in so far as he ascribes it to exclusion of germs.

Mr. Lawson Tait, in reporting "a series of one hundred and twelve consecutive cases of operations for ovarian and parovarian cystoma without a death," and in which no antiseptics were employed, says: "I tried the so-called antiseptic system in all its ever-varying details in as complete and unprejudiced a series of experiments as I believe it possible for man to undertake." . . . "I finally came to the conclusion that my patients were being poisoned by the use of carbolic acid, thymol, and various other substances, which were being used by others as well as myself for the purpose of destroying the germs which were supposed to do so much harm," . . . and he adds, that his experience had proven to his own satisfaction conclusively that he "could do better without Listerism than with it; that, in fact, the only tendency of this so-called antiseptic system was to mar" his success.

In the light of all that has already been said upon this subject, no one familiar with Mr. Tait's careful and painstaking mode of operating, will fail to see where lies the real secret of his hitherto unparalleled success, and which he himself says is due to "increased personal experience, increased attention to all the minute details which go to create success, and inattention to any one of which may defeat the best-laid plans." "In every case," he adds, "where there has been a tendency to ooze, or where the patient has been advanced in life, I have used the drainage-tube, an addition to our means of saving life of which it is impossible to speak too highly."

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[1] McGill, *Med. Record*, January 23, 1886, p. 110.

I agree fully with Mr. Tait, that this simple narrative of his personal experience, the accuracy of which is assured by his acknowledged integrity, and by abundant collateral testimony, ought to "dispose forever of the much-discussed question of Listerism in abdominal surgery."

Mr. Keith is equally emphatic with regard to the evil effects of antisepsis in abdominal surgery, and he has abandoned it with improved results.

Says Bernays, "in numerous *laparotomies* and other capital operations, I have good reasons to be satisfied with my results. Since I have abandoned Listerism, and after referring to the necessity for cleanliness, care, etc., he adds, "clean water was used, unadulterated by bichloride of mercury, carbolic acid, or any other poison." Even Mr. Lister himself, after listening to the discussion of this subject in the British Association, declared his conviction that antisepsis was not advisable in abdominal surgery.

Incidentally I will add that the experience of the distinguished surgeons above referred to ought to furnish a beam of light to those surgeons who, during the last three or four years, have been prophesying the brilliant future of gunshot wounds of the belly under a "strictly antiseptic treatment," according to whom the time was near, if it had not actually arrived, when, under the protective influence of antisepsis, surgeons would, in their zeal to find these missiles, open the belly freely, unravel the intestines and close their wounds, search carefully through every pocket of the peritoneal cavity, and, if need be, dissect and explore the regions outside of the peritoneum, and, having found and removed the lost ball, they would wash out the fecal matter and the blood which had necessarily escaped into the peritoneal cavity, and close the abdominal wounds, with a reasonable probability of restoring the patient to life and health.

I am not prepared to say that surgeons have not exaggerated sometimes the dangers and difficulties of searching for balls which have entered the cavity of the belly, and of searching for intestinal and vascular lesions which may not have occurred, or which, if present, are often repaired by the unaided resources of nature, but I do not think so; and I believe that all surgeons who have had much experience in this class of injuries will agree with me. I only intend to say that antisepsis has in no degree abated these dangers and difficulties.

These remarks are made by the author with a full knowledge of the results of certain recent operations made for the purpose above indicated.

Before dismissing this subject it seems necessary to consider briefly certain relatively modern suggestions, other than antisepsis, which have been made for the purpose of securing the primary union of large incised wounds.

"Bruising" the vessels, first suggested by M. Briot, and "torsion," which owes its introduction to M. Velpeau, are both still practised upon the small vessels with a certain degree of success, but in my personal experience both have more often failed.

Veitch, in 1806, used for the ligation of both large and small vessels very fine silk, and cut off the ends, leaving the knot in the wound to become encysted; but as small abscesses subsequently formed in many cases, Ruysch, of Germany, and Physic, of this country, substituted animal ligatures, and treated them in the same manner. Valentine Mott says, like the silk ligatures they often formed abscesses, and after a short time their use was almost entirely abandoned.

At the present time we see the practice of using the animal ligature revived, but only, for the most part, in its application to small vessels upon the surface of the wound. In this manner they are now used quite freely, and no doubt serve the purpose of shortening the period we may have to wait before closing the wound, and of giving additional security against secondary hæmorrhage during the early period of reaction. Notwithstanding the statements made to me by some surgeons, that they have seen no abscesses follow their use, this has not been my experience. In at least two cases out of the few in which I have adopted this practice, very small abscesses have formed. I must, therefore, consider the method as still under trial.

The substitution of cloth or a towel for the sponge, as a means of removing the blood from the surface of the wound, made, as I understand, for the purpose of protecting the patient against septic germs, is subject to the criticism that it is illogical. If germs can be destroyed which lie exposed upon the surface of a wound, or upon instruments, they can equally be destroyed when they lie secreted in sponges, by a thorough saturation with some disinfectant, or by boiling water; and if they cannot be so disinfected, neither can the towel be. I observe, however, that in using the towel it is only laid upon the surface, not drawn roughly over it, and in this practice I see a positive gain. When a sponge is drawn roughly over the quick and sensitive wound, in the case of a patient who is not anæsthetized, it causes most acute pain; and although when the patient is insensible it can no longer cause pain, it can fret and partially disintegrate the surface as when rasped by a file. If surgeons' assistants cannot learn how properly to use a sponge, let them use a towel.

Drainage-tubes made of bone, from which the mineral structure has been removed, and which, therefore, may become dissolved, or even absorbed, present no possible advantage over the ordinary india-rubber flexible tube, except that, if by any accident they should escape into the wound, they will take care of themselves and probably do no harm. The objection to them is, that they are short and inflexible, and cannot be made to follow a long and tortuous canal.

In closing the wound some modern surgeons have given the preference to metallic sutures, others to the animal sutures, or to horse-hair, for each of which it is claimed that they cause less irritation than silk, and in this way improve the chances of primary union.

Any suture, no matter of what material composed, will cause irritation and suppuration at the points of pressure, if it is employed upon tegumentary tissues for the purpose of drawing the lips of the wound together forcibly, as when, owing to a deficiency of structure, they could not otherwise be made to meet; but I have elsewhere explained that this is not, in tegumentary wounds, and but rarely in any wound, the proper function of a suture.

In the class of cases now under consideration, where we desire prompt primary union, the suture is intended only to place the edges of the wound in accurate apposition, and to prevent inversion. For this purpose the finest silk suture, introduced as near the margin of the wound as possible, and tied lightly, is the best. It will cause no more irritation than the wire or horse-hair, is much more flexible and adjustable, and is, therefore, much more easily and painlessly introduced and removed. The accuracy of these statements I have frequently verified by employing the two materials on different parts of the same wound.

The value of the animal suture consists solely in its being spontaneously removed. If it be claimed that its value, as now generally employed, consists in its being carbolized, the reply is, that the silk may be treated in the same way. The only objection which I have to its use is, that it less flexible than silk, and is not so fine as the finest silk.

Hot water, as a means of imparting a healthy stimulus to paralyzed tissues, of arresting capillary hæmorrhage, and of removing the blood from the surface of the wound, has long been employed by me, applied by means of a sponge, and in other ways.[1] The suggestion of Dr. Varick, to apply it in a continuous stream from the nozzle of a pipe connected with a reservoir, in the same manner in which the antiseptic solutions are now often employed, commends itself theoretically and by its results. A current of hot water, falling with moderate force upon the wound, not only removes the blood from the surface, but also washes it from the tissues where it has accumulated around the bleeding orifices of the small vessels, exposes them to view, and enables the surgeon to apply a ligature if required. It also coagulates the albumin, and for this reason, if for no other, it ought to be satisfactory to those who believe that by the interposition of this shield the vessels are protected from the intrusion of germs; while it is absolutely innocuous, a quality which is not possessed by any of the antiseptics, so called, now in use. The occasional toxic effects of carbolic acid and of the bichloride of mercury, in their surgical application, are known and admitted by all the advocates of antisepsis.

Dr. Varick recommends that the water have a temperature "slightly below the boiling-point." Dr. McGill says that it will not coagulate the albumin at a temperature of less than 140° Fahrenheit, and that he employs it at or above this temperature.

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[1] "Warm and Hot Water in Surgery," *Richmond and Louisville Med. Jour.*, Jan., 1874. *The Medical Record*, May 15, 1874, by the Author.

Alcohol was employed for a similar purpose, namely, to resuscitate the tissues, and in various ways, by Paré, Percy, and Larrey, and still later by Nelaton, Sec, Perrin (1879), and many others. Perrin uses the commercial alcohol of full strength. No doubt, its effects, when poured freely upon the wound of the patient whose tissues have been paralyzed by complete and prolonged anæsthesia, would be the same as those produced by hot water, and may be properly used by those who choose to make the substitution. Borlie employs in the same manner the spirits of camphor, and, as he affirms, with equally good results.

For the sake of unity in the consideration of the subject, and at the risk of repeating some things which have been elsewhere said in this treatise, I will add a few suggestions as to what more needs to be done in the dressing and subsequent management of large incised wounds.

Adhesive straps are not in all cases required. Their purpose is, in most cases, to give support to the flaps, and to relieve the sutures from any possible strain which may come upon them on the accession of inflammation and swelling. In many cases they can be properly dispensed with, and in no case of a large wound should they be permitted to cover all points of the wound, since by this arrangement they prevent the outflow of blood and serum, and of pus, if it should form. They never should be applied very tightly, lest they cause ligation when the parts become swollen. As to the material to be employed, the ichthyocolla, or isinglass plaster has the advantage that it can be easily removed by water. Resin plaster, or the common "adhesive plaster" of the shops, if fresh, and the India-rubber plaster, are more adherent, but they are removed with more difficulty, and sometimes cause a moderate local irritation, or erythema.

To prevent the subsequent dressings from adhering to the wound, simple cerate spread upon sheet lint is generally to be preferred. If it is not fresh, it should be subjected to a boiling temperature before being used. Vaseline, now so commonly employed, is too fluid, and does not so well prevent the sticking. In very warm weather, melted fresh tallow is sometimes preferable to simple cerate.

If, for any reason, the surgeon gives a preference to dry dressings, the powdered bicarbonate or subnitrate of bismuth will serve the same purpose as the iodoform powder, and is never, like the latter, liable, by absorption, to cause blood-poisoning. The chances of this occurrence from iodoform is, however, too small to entitle this objection to much weight.

Upon the dressings as now completed, a mass of "absorbent" cotton batting should be laid, its surface extending considerably beyond the portion of integument covered by the dressings, for the purpose of receiving any discharges which may escape from the wound, and for the purpose of supplying an elastic medium by the interposition of which, while the underlying tissues and flaps receive an adequate support, they shall not be subjected to any risk of strangulation from the bandages.

The bandages, or roller, must now be applied with sufficient firmness to ensure support, and a complete coaptation of the deep portions of the wound.

As to the period of the first dressing, and the frequency of the subsequent dressings, much must be left to the discretion of the surgeon. If there are no indications of excessive reaction, or of imprisonment of the discharges, the dressings need not be disturbed for several days; but if the facts are otherwise, daily dressings may be required. In the case of stumps, it has been my general practice to make a complete section of the roller, in the direction of the axis of the limb, at the end of twenty-four hours, to ensure the limb against strangulation, and then to stitch the cut bandages lightly together. By this, all disturbance of the limb is avoided at a period when the slightest disturbance may cause a separation of the surfaces of the wound, and thus effectually defeat primary union.

At whatever period it is decided to remove all of the dressings and renew them, infinite care should be exercised in handling the parts, for the same reasons which I have above given.

It seems necessary to add, in view of a practice which I have seen frequently adopted, that throwing water into the drainage tube, under a high pressure, in the early stages of the treatment, ostensibly for the purpose of disinfecting a wound, is, in all cases where primary union is hoped for, attended with the risk of disturbing the union and of defeating the end which the surgeon has in view.

Returning after this digression to the consideration of antisepsis, I wish to say, that while it seems to me capable of demonstration that the real secret of Mr. Lister has lain concealed under a series of complicated manipulations, my confidence in the intelligence of my professional brethren is such that I believe they will soon abandon all those procedures which are irrelevant and wholly unnecessary to success. This is what they have already begun to do. In addition to those whose names I have mentioned, Mr. Keith, Mr. Tait, Mr. Savory and Bernays, I may refer to the late Mr. Callender, Mr. Bryant, Ashhurst and Gunn. Mr. Bryant, speaking of Listerism, says, "I am no convert as yet to the theory upon which it is based, nor to the great value of the special practice based upon it: neither is yet proved."

Mr. Callender, in the St. Bartholomew Hospital Reports for 1874, when defending his own practice, says, that in forty-four consecutive amputations, without antiseptic treatment, he had but one death. Ashhurst, in the last edition of his excellent treatise on surgery, declares that the alleged superiority of antiseptic surgery cannot be said to have been as yet domonstrated; and Agnew, who favors antisepsis in general, when presenting certain statiscics relating to amputations, says that "the comparative mortality following the antiseptic, and the carefully applied ordinary dressing after amputation, is left unsettled."

It is a just ground of complaint, that the advocates of this practice do not furnish us with any reliable and comprehensive, comparative statistics in support of their often repeated general statements that their success is greater than the success of those who adopt any other plan of treatment.

Mr. Savory said in 1879, before the *British Medical Association*, that there were "no statistics showing better results from Lister's than from any other methods, in fact none quite so good." This public statement and challenge have remained practically unanswered to this day. I will add that the advocates of Listerism have always refused—and very properly—to admit in illustration of the value of their practice, any cases in which there has been any failure to comply with *all* of the conditions which they consider essential to complete success; and if statistics are hereafter to be furnished as a basis of comparison,.we have a right to claim, not only that in the one case all possible "antiseptic precautions" have been adopted, but that in the other, the treatment first outlined by Alanson, and perfected by his contempories, and by those distinguished surgeons of a later day who enrolled themselves as his disciples, should be carried out absolutely and exactly in all its details.

Finally, if the reader discovers in what has been here said, reasons for severing his attachment to certain modern theories and practices, let him be careful that he does not lose his hold upon anything. whether new or old, which is really useful. Antiseptics have their position and function in a great variety of wounds, including large simple incised wounds, under certain circumstances, and at certain stages of their progress. What this position is in the latter class of cases especially—whether it be dominant or subordinate—is what alone I have attempted to indicate.

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